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Interpretation of X-Ray Pictures of Apical Granulations, Giving Differential Diagnosis of Cases Favorable and Unfavorable for Treatment and Root-Canal Filling—*Hinman-Johnston*

The Cast Gold Base—*Holaday*

Cleansing the Mouth—*Kells*

Institutional Dentistry—*Keyes*

Should All Pulpless and Impacted Teeth Be Removed?—*Logan*

Clinical Studies of Pulp Treatments—*Black*

Cast Full Upper Denture—*Stansberry*

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Calendar of State Society Meetings

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H. E. FRIESELL, B.S., D.D.S., F.A.C.D.
President, National Dental Association

THE JOURNAL
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Original Communications

THE INTERPRETATION OF X-RAY PICTURES OF APICAL GRANULATIONS, GIVING DIFFERENTIAL DIAGNOSIS OF CASES FAVORABLE AND CASES UNFAVORABLE FOR TREATMENT AND ROOT-CANAL FILLING

A Symposium Presented before the Chicago Dental Society, October 9, 1920, by Thomas P. Hinman and Harry B. Johnston

By THOMAS P. HINMAN, D.D.S., F.A.C.D., Atlanta, Georgia

THE question of differential diagnosis between salvable teeth and teeth that should be extracted is one that has given the conscientious practitioner more real anxiety than any other problem in present-day practice and it is the intention of this paper to make clear, if possible, some of the points in differential diagnosis as shown by the X-ray pictures.

When it has been determined that a pulpless tooth showing a rarefied subapical area is to be treated with the expectancy that this subapical area will return to normal, the following questions arise: (1) What is the condition of the apical cementum and how can this condition be determined? (2) What is the condition of the subapical bone and how may we determine this? (3) After determining that conditions are favorable for treatment, what methods should be used to bring about a condition favorable for restoration of the subapical bone, and may we expect a reproduction of the destroyed area? (4) In what length of time should we expect bone restoration? (5) Are teeth so treated no longer a

menace to health? I will endeavor to answer these questions seriatim.

1. What is the condition of the apical cementum and how can this condition be determined?

First, the condition of the apical cementum may be determined by the careful examination of good, clear X-ray pictures, not the usual type so often seen in which a central incisor root is shown to be so long that it looks like a Lombardy poplar, but a picture that shows accurately the root length, the end cementum, the lamina dura and bone trabeculae. If an attempt is made to show the relation of the tooth to the peridenal membrane, to the lamina dura, to the apical cementum, and to the subapical bone, it is extremely important to show the relation definitely without either foreshortening or extreme lengthening of the shadow picture. If a question arises as to the lack of definiteness of these areas, then the tooth should be photographed from three distinct angles. If it is the incisor, it should be photographed labio-lingually, focusing on the central portion of the tooth; then a picture should be made using the mesial angle as a focal point; and for the third one, the distal angle should be used as a focal point. It is sometimes astonishing how much information, which the single picture has not clearly revealed, can be obtained from the additional pictures (Figs. 1-4).

If the apical cementum shows rarefaction, no amount of treatment will avail. On the other hand, if the apical cementum shows no rarefaction treatment is indicated. If the apical cementum shows condensation, treatment is again indicated. In cases where we have condensation, or adventitious cementum, the sections of these root ends have shown that the majority of the foramina are closed; frequently only a single apical foramen is open, from which it would seem that nature has endeavored to close off infection. This condition of the apical cementum is clearly shown in correctly taken, accurate X-ray pictures.

1 2 3

Figs. 1-3.—Fig. 1 is incurable; note the rarefaction of the apical cementum. Fig. 2, lateral incisor, showing cemental rarefaction; central no apical rarefaction; prognosis favorable. Fig. 3, first bicuspid, showing cemental rarefaction, incurable; second bicuspid, no apical rarefaction, prognosis favorable.

2. What is the condition of the subapical bone and how may we determine this?

The condition of the subapical bone should be clearly shown in the X-ray picture and is readily determined by a correct reading. This condition is of great importance in determining the question of treatment, for if this bone is infiltrated and there is no definite limited area, we have a condition of bone infiltration known as rarefying osteitis. The area of destroyed bone is usually very much larger than is shown by the X-ray picture. This has been deter-

mined by frequently cutting down on these areas and examining them.

Cases of this type do not yield readily to treatment, and where the area is of considerable extent treatment is contra-indicated even if the apical cementum be in very good condition. It has been noted in these cases that the resistance of the patient is, as a rule, very low and nature apparently has made very little effort to wall off the infection and prevent its spreading. In treating destroyed apical areas, the general physical condition of the patient should always be a consideration.

In the other type, where the destroyed area is surrounded by a line of condensed bone which seems to limit the infected area, apparently nature has attempted to wall off this diseased area and a condition very similar to that shown by Sir Kenneth Goadby in his *Bone Studies of Latent War Wounds* is apparent. Sir Kenneth Goadby calls these areas "loculi." Areas of this type, where they are not too large, bid fair for treatment if the apical cementum is not absorbed or shows condensation.

After determining that conditions are favorable for treatment, what methods should be used to bring about a condition favorable for restoration of the subapical bone, and may we expect a reproduction of the destroyed area? For a great many years, the treatment of root-canals and periapical diseases has been empirical, and we are all familiar with the old methods of the use of the essential oils, phenol, iodine, etc., and apparently these methods are still in vogue in some localities. The futility of these procedures is too well known to require comment, but there is one thing to which I wish particularly to call your attention and that is to the nostrums which are on the market for the purpose of clearing up these diseased areas. These nostrums are advertised in our dental journals, and that operators are using them to some extent is indicated by the immense sale they have. As the tooth does not give any trouble after the canals are filled with these materials, the dentist believes that the disease has disappeared, but as a matter of fact they are the most dangerous of all materials used in root-canals, for in a majority of such instances the substance used has pernicious power to reduce the vitality of the apical cementum as well as the periapical peridental membrane, and by lowering their vitality and resistance produces a nidus liable to infection either thru the blood stream or by the lymphatics, as has been shown by Noyes.

The use of any medicated material in filling root-canals is both unwise and unnecessary. If the material used has sufficient germicidal power to destroy bacteria, it will also have sufficient power to lower the vital resistance of the apical area. It has been my observation that any substance which contains formaldehyde gas is a dangerous substance to use in a root-canal.

About four years ago, it was decided in our office to adopt a definite technic in all root-canal work. This technic will be shown by my associate, Dr. Harry B. Johnston. It is based on a series of experiments I made with egg albumen and the method used is electro-medication, or so-called ionization, combined with the proper root-canal technic and root-canal filling. The experiments which I allude to were made with the idea of finding just exactly how much electric current was required to coagulate albumen. They were made in the following manner:

A hole was bored in the bottom of a test-tube and a small platinum wire inserted and sealed in place. The tube was then filled with egg albumen within about one-half inch of the top. In this albumen was imbedded a tooth the root-canal of which had been opened and thru which a platinum wire had been passed. Electric wires were then attached to these terminals and the millimeter was carefully watched as the current went thru the tooth into the albumen. It was

found that anything over a half milliampere would produce immediate coagulation of the albumen and a destruction of this substance in the area of the apex. Therefore it was determined that the amount of current we should use should not exceed a half-milliampere. In fact, we seldom go that high.

It should be readily understood that if the area beyond the apex was coagulated or cooked, the active passage of any medicine used in ionization was greatly limited, and the penetration of medicine into the subapical tissues was prevented. If low milliamperage is used, the ions are carried into the tissues. For a long time we used 3 per cent chloride of zinc with a pure zinc point, the electric current being applied for about fifteen minutes, but this technic has been changed, as will be shown by Dr. Johnston.

The idea of the electric current producing coagulation and preventing the further penetration of medicine was given me a great many years ago by Dr. F. T. VanWoert of Brooklyn, now of New York City.

The results of these experiments have been carefully checked and will be shown you by Dr. Johnston in his slides. I wish to observe that in the pictures Dr. Johnston will show there is an apparent reproduction of the lamina dura, the rebuilt bone clearly shows trabeculae, and the whole area is not sclerotic but apparently normal.

4. In what length of time should we expect bone restoration?

The length of time required to rebuild the destroyed area around apical root ends is from four to twelve months, this depending very largely on the amount of area destroyed.

5. Are teeth so treated no longer a menace to health?

So far as we have been able to judge, after four years of experiment, teeth that have been so treated, which show a bone restoration of the character of which we are speaking, have not produced any injury to the patient. In fact, where we have cleared the mouth of other teeth which have been more seriously diseased and have extracted these teeth, there has been no return of the symptoms from which the patient was suffering.

4 5 6

Figs. 4-6.—Fig. 4, a first bicuspid showing apical rarefaction, prognosis unfavorable; second bicuspid, showing condensing cementosis, prognosis favorable. Fig. 5, pyorrhea, showing rarefying osteitis; unfavorable diagnosis. Fig. 6, pyorrhea, showing condensing osteitis; favorable prognosis.

While on the subject of diagnosis, I wish to call your attention to a few pictures of cases of pyorrhea which will definitely show extreme bone condition, and these pictures are used as a means of diagnosis before any treatment is indicated.

Where the bone shows disease of the rarefying type (Fig. 5), it is seldom wise to attempt any treatment, but where the bone shows a condensing

line (Fig. 6) the cases usually yield readily to treatment. It is astonishing to note what a small amount of bone will hold a tooth firmly in position if the surrounding area is of the condensing type. Many cases of pyorrhea which do not get well are of the rarefying type, and where the bone is all infiltrated, as it is in a number of cases, treatment, as a rule, is of no avail.

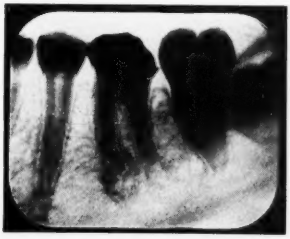


Fig. 7.—Second molar showing root end incomplete, not yet formed; dark spots appear at first molar and second bicuspid root end (osteogenesis).

I wish it clearly understood that we are not claiming anything for this method but we are simply showing you the results of four years of constant work along one line. During these four years of time, we have not varied from our technic and methods of treatment but have, in experimental cases, used other methods. Our experience has been very unsatisfactory with any other method than the one shown.

It might be interesting to note that all of these pictures are taken with a gas tube. Thus far we have not been able to get tubes of other types to do work as satisfactorily for us. We use a seven-inch tube, a four-inch spark back up, twenty-five milliamperes per current, twenty-five milliamperes per current, four to five seconds exposure (Fig. 7).

THE POSSIBILITIES OF THE CALLAHAN METHOD

By HARRY B. JOHNSTON, D.D.S., Atlanta, Georgia

PART I

PERMIT me to say at the outset that I have studied in detail and extensively experimented with a great many methods of canal opening and filling and have chosen the Callahan method because of immeasurably superior results obtained, particularly so since adopting some slight modifications of, and additions to, the original technic.

It is my contention that with the Callahan method it is not only possible but easy to fill and hermetically seal canals heretofore considered impossible.

Briefly stated, the Callahan method consists of the use of dilute sulphuric acid as a decalcifying medium to assist in opening the canals, followed by a saturate solution of sodium bicarbonate, causing a rapid effervescence which effectively clears out all debris. The acid is also a powerful tho superficial germicide. After dehydration the canal is flooded with a solution of chloroform and fiddle-bow resin in the proportion of twelve grains of resin to three fluid drams of chloroform. A point of pure base plate gutta-percha, only slightly shaller in diameter, but longer than the canal, is then selected, passed into the canal and caused to dissolve in the chloroform by a rapid tho delicate pumping or stirring motion. We will now

take this up step by step and study the "what" and "how" of it.

Sulphuric Acid as a Cleansing Agent

For this purpose 30 to 50 per cent aqueous solution of the chemically pure acid is used. It softens the wall of the canal by a process of decalcification so as to permit easy and fairly rapid enlargement of its caliber by curetting with various instruments. The most valuable factor in the use of the acid, however, is that it may safely be sealed in the canal, thereby giving it time to diffuse thru accessory canals which cannot be reached with any instrument and can be treated *only* by grace of the law of diffusion of liquids. It must always be borne in mind that our only real problem is to *fill these accessory canals and seal their foramina.* By diffusion, the sulphuric will penetrate these more safely than any other chemical now at our disposal. It is far from being as effective in dissolving the organic content of these canaliculi as we would like, but so far the prime factor of safety to the patient has prevented the sealing in of any more effective solvent; for bear in mind that these canaliculi can be reached *only* by diffusion, which requires time. The organic matter in the canals and canaliculi is attacked to a marked degree, caused to yield up its water, shrink and release its hold upon the tube wall. The effervescence caused by the addition of the soda will then break it up and re-

1 2 3

Figs. 1-3.—Fig. 1 is large lateral canal with rarefied area about midroot on first bicuspid. Fig. 2 shows a number of very minute apical canaliculi too small to be shown by radiograph; no visible connection between the "button" and the main canal. Fig. 3, lateral, showing one large and one small canal, and cuspid showing one large and two small apical canals.

4 5 6

Figs. 4-6.—Fig. 4, bicuspid showing lateral canal given off at right angle to main canal. Fig. 5 molar showing two foramina on lingual root and a parallel canal given off at gingival third in mesio-buccal root; this could be filled only by diffusion. Fig. 6, unusual bicuspid showing four apical canaliculi and one lateral right angle at beginning of apical third. Pressure here of no avail. Filled with a single gutta-percha point by diffusion.

move it cleanly from the larger canals and to a considerable extent from the smaller canaliculi. But altho the organic matter is not perfectly removed from these, part of that remaining is forced out of the foramina into the tissues where it is promptly digested and the remainder encapsulated in the filling.

The advantages of dilute sulphuric acid then appear to be as follows: (1) It permits of the rapid and perfect cleaning and enlarging of the main canal. (2) Its marked affinity for water causes its rapid diffusion thru all the accessory canals where its well-known oxidizing properties have a burning or charring effect upon dead tissue. (3) The addition of soda produces such a violent effervescence that not only this debris but frequently even broken instrument points will be forced out by it. (4) Last, but by no means least, it may be safely sealed in the tooth, which will allow ample time for this diffusion thru all canals and canaliculi, enlarging them by a self-limiting decalcification and cleaning and sterilizing by oxidation.

7 8 9

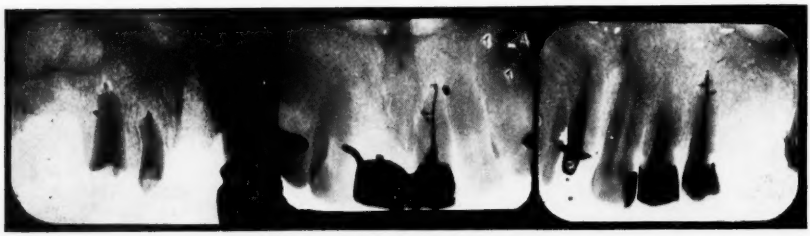
Figs. 7-9.—Fig. 7, accessory canal in mesio-buccal root completely cut off from pulp chamber by secondary dentin, communicating canal at midroot made it possible to perfectly fill and seal this entire canal, the presence of which was not even suspected. Fig. 8, lateral right-angled canal in bicuspid; this type of accessory canal very common in bicuspids. Fig. 9 shows two minute buttons on apico-distal surface which have no visible connection with main filling; also shows folly of forcing an opening entirely thru the root.

We might as well settle the question, "Are you not afraid you will get some of the acid thru the apex?" Yes, I am, and you sometimes do, even if your technic is the most careful, but all of our present methods are so imperfect in one point or another that no man can reasonably expect to get perfect results in every case by any method. With reason-

10 11 12

Figs.10-12.—Fig. 10, apical portion of canal turned distally at right angle, no actual "apical" foramen; to have forced an instrument entirely thru the canal would have resulted in a root puncture. Fig. 11, upper first bicuspid with a single canal to midroot where it divides into three—two extending to apex and one lateral canal at midroot—all three perfectly filled with one gutta-percha point by diffusion. Fig. 12, lower bicuspid with a number of apical canaliculi filled and sealed.

able care, however, this result would be the very great exception; for bear in mind that any liquid you place in the canal does not go ahead of the instrument but follows it, and you are much more liable to get a laceration of the chamber flooded with 50 per cent acid and the canal entered with a fine or extra fine Kerr pulp canal file. This is gently passed in until it hangs. It is then given about one-eighth twist, held in that position, and withdrawn. This is



13 14 15

Figs. 13-15.—Fig. 13, upper central with lateral right-angled canal given off from pinhole; presence unsuspected until radiograph revealed it filled. Fig. 14, upper central with two lateral right-angled canaliculi; presence never detected until after they were filled. Fig. 15, bicuspid with four apical canaliculi filled by diffusion.

periapical tissue from your instrument point than an irritation from the acid. In a root having a large foramen you have only slight need for the acid, and it, repeated, pumping the acid in thoroly until the instrument and acid have penetrated to about the apical third or has gone as far as it will easily go. The

16 17 18

Figs. 16-18.—Fig. 16, upper cuspid; main foramen not at apex; shows three foramina sealed. Fig. 17, large rarefied area on lingual root. Fig. 18, same tooth as in Fig. 17 six months after treatment. Also shows bifurcation of lingual canal.

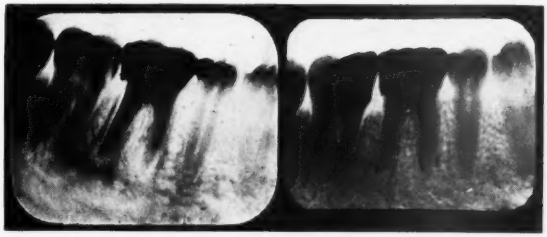
like any other similar agent, must be cautiously and sparingly used in this type canal. It should not and need not be sealed in a canal of this kind.

Technic and Instrumentation

After the canal has been freed of pulp tissue, or old filling, the crown of the tooth is coated with cavity varnish, sandarac, or chloro-resin, the pulp next smaller size file is then used and the opening and pumping continued slightly farther. Measuring wires may be used at this point if desired. No instrument larger than the finest smooth broach, or pathfinder should ever be passed thru the foramen if it can be avoided. In the majority of cases it is easy to tell when you are about to enter the foramen as there is a slight constric-

tion just short of the actual opening. The acid should be thoroly pumped to this point and neither acid nor instrument carried any farther. It is difficult to coax the acid to this point and there is small danger of getting it any farther, except, of course, in the very large canals. The acid is neutralized at frequent intervals removing the debris, and just before sealing the cavity and dismissing the patient, fresh acid is pumped into the canal, the surplus absorbed out of the pulp chamber, a pellet of sterile cotton placed in, and the cavity sealed with hot temporary stopping without pressure. This may be left in for any length of time that may be desired or necessary, as the acid is self-limiting in its action and, due to the alkalinity of the lime salts of the dentin, does not remain active for more than two or three hours.

If the canal in which you are working is not perfectly straight and your Kerr file hangs at some point, or suddenly fails to penetrate farther, remove it from the canal, and with your radiograph as a guide, bend the point of the file slightly, reintroduce into the canal, and probe for the opening into the remainder of the canal. The very great majority of canals can be freely and easily opened if we can bend our file to approximate the curve of the canal. Force plays no part in the opening of a pulp canal—it must be done by "persuasion."



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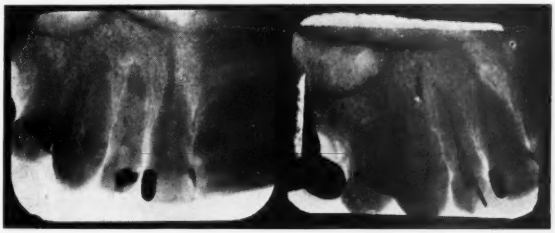
Figs. 19, 20.—Lower molar before and twelve months after treatment. Shows complete restoration of lamina dura around mesial root and very great improvement on distal root.



21 22

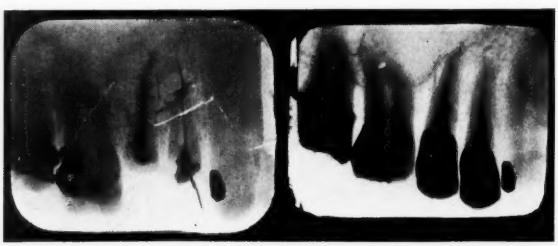
Figs. 21, 22.—Upper lateral before and twelve months after treatment. Shows complete restoration of lamina dura.

Let us study for a few moments just what the acid does while it is in the canal and how it does it. In a pulpless tooth all of the canals and canaliculi

are as a rule filled with decomposed organic matter in aqueous solution. That can be removed from the main canal by absorption, but it cannot be so removed from the fine accessory canals. When the main canal is flooded with the acid then the law of the diffusion of liquids comes to our help, and as the 50 per cent of water contained in the acid solution is not sufficient to satisfy the acid, it takes up more water from whatever source it can gather it. Sealed in the tooth, its only available supply is contained in the accessory canals and to some extent in the tubuli. It can gather but little from the tubuli, however, because of the wall of calcium sulphate which it quickly builds up around itself and which prevents its further penetration. It must therefore act upon the watery content of the accessory canals, which it promptly does. The water in these canals is drawn into the acid and the acid flows back into the canals. In other words, sufficient of the water and the acid change places to produce a balancing of the solution. Does any of this acid diffuse into the tissues beyond the foramen? Not unless the apical tissue has been broken down and replaced with cystic fluid. Its action in coagulating albumen will not permit it to actually enter living tissue. There again it is self-limiting. It must have a fluid medium and finding such in the accessory canals it follows them to the ends, oxidizes and breaks up the dead tissues contained in them, and destroys

23 24

Figs. 23, 24.—Lower molar before and four months after treatment; large swelling of kneejoints completely disappeared in two months and still normal (two years later).



25 26

Figs. 25, 26.—Extensive lateral (but no apical) rarefaction, immediately after treatment and two years later; all secondary symptoms promptly disappeared and have not returned.

the bacteria. In treating the canal it is not possible to ascertain where these accessory canals are, their number, nor direction; but if they are present (and we are told by excellent authorities that they always are) the acid will find them.

27 28

Figs. 27, 28.—Lower molar before and six months after treatment, showing complete restoration of lamina dura around distal root; presence of "button" on mesial root retards filling in.

Subsequent application of fresh acid followed by the soda will result in the complete removal of all organic material from all of these canals excepting those

29 30

Figs. 29, 30.—Cuspid before and ten months after treatment; slight arthritis disappeared in two weeks.

exceedingly small and quite longer than the average.

It might be well at this point to explain the part that capillary attraction plays in this process. Capillary attraction has practically nothing to do with it, and what little part it does play is confined entirely to the main canal.

There are two kinds of capillary attraction which I will for convenience call primary and secondary. Primary capillary attraction is that attractive force exercised by the walls of a glass or other non-porous capillary tube. If this type of capillary has one end closed either by fusing, by placing a minute quantity of liquid in it, or being surrounded by the periapical tissues, as is the case with the root capillary, its force of attraction is completely broken. Therefore there is no such thing as capillary attraction of the primary type in the root-canal of a tooth. That which I have called "secondary capillary attraction" is exercised by any porous substance capable of absorbing water or watery solutions, and its force is neutralized when the microscopic capillaries of the substance become filled with the solution. Therefore it will be seen that if

you can dehydrate the walls of the canal and accessory canals you can put this type of attraction in force. This, however, cannot be done in the accessory canals, and so these canals (or canaliculi) which constitute our great problem in pulp-canal filling can be reached, cleaned, and filled only by diffusion. In other words, you can only get one substance out of them by substituting another.

31 32

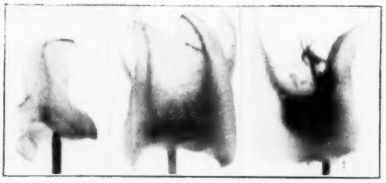
Figs. 31, 32.—Central and lateral immediately and six months after treatment.

Filling the Canaliculi by Diffusion

When we have finished with our acid and neutralized it for the last time, our canaliculi are filled with water, holding any chemical compounds in solution. The water effectively bars the entrance of our chloro-resin solution, so we must substitute something else for this water, something which has an affinity for chloroform. Alcohol is ideal for this purpose. The main canal is then flooded with 95 per cent alcohol, which is thoroly pumped and churned into it. By diffusion this substitutes for the water in the canaliculi, filling them with a lower-grade alcohol. Ample time must be allowed for this, for if the canaliculi contain less than 85 per cent alcohol, the chloro-resin will not diffuse thru them. This usually requires from three to five minutes. All of the alcohol which can be removed with absorbent points is then taken out and the pulp chamber and canal flooded with the chloro-resin. No pulp-canal driers or hot air must be used at this stage, for we wish the

33 34 35

Figs. 33-35.—Fig. 33, extremely curved lingual root of upper third molar. Opened with Kerr files and filled by Callahan method—wet specimen, two foramina (decalcified). Fig. 34, extremely curved root of upper third molar; opened with Kerr files and filled by Callahan method, low-power glass necessary to see apical portion of filling in decalcified specimen. Fig. 35, lower third molar; Kerr file only instrument that could be coaxed around these curves; filled by Callahan method, then decalcified.



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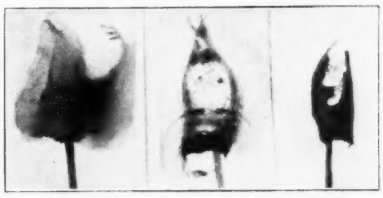
Figs. 36-38.—Fig. 36, extreme curvature with sharp angular turn; Kerr file coaxed around it by bending point before entering it into canal; specimen not stained but filled with gutta-percha, using mouth technic. Fig. 37, only one accessory canal shown in this view of specimen but there are others; could not be filled by pressure, but diffusion does it easily. Fig. 38, rudimentary second mesio-buccal root showing three apical canaliculi, one communicating canal and webb, and one blind canal (no foramen); filled by diffusion using mouth technic with wet specimen.

canaliculi to remain filled with alcohol. The chloroform diffuses perfectly and rapidly into the alcohol, and inasmuch as the resin is in perfect solution in the chloroform, wherever the chloroform goes the resin goes. Time is required here also. It is not a "slam-bang" process. Allow from three to five minutes here, pumping in fresh chloro-resin as the chloroform is soaked up by the tubuli and canaliculi or passes off by evaporation. Toward the end of this period, when the solution in the canal begins to get rather heavy, add pure chloroform



39 40 41

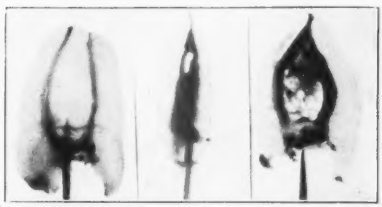
Figs. 39-41.—Fig. 39, mesio-buccal root showing three apical canals in this view. Fig. 40, mesial root of lower molar showing three apical canals and webb connecting main canals; webb cleaned out by diffusion of acid and filled by diffusion of gutta-percha; wet specimen; mouth technic. Fig. 41, mesial root of lower molar showing very delicate webb filled with gutta-percha, tooth not visible because of high transparency of specimen.

as needed to keep it sufficiently thin to dissolve the gutta-percha point.

When this third substitution or diffusion is complete, a gutta-percha point of suitable size and shape is then passed into the canal and dissolved by either a pumping or stirring movement, which movement you use is governed by the size of the foramen. With a normal, small foramen, a pumping movement is best; with a large foramen this would force too much chloro-percha thru, therefore a stirring movement is used.

Just how beautifully the gutta-percha will diffuse thru the chloroform is shown by the illustrations of decalcified teeth and radiographs of teeth filled in the mouth.

We are told, and correctly I think, that chloro-percha in hardening shrinks from the periphery. In other words, it releases the walls of its container. And we are also told that chloro-resin-percha in hardening shrinks from the center, or clings to the wall of its container by virtue of the strong adhesion of the resin and the fact that tiny threads of this material actually enter the tubuli. An excellent way to assist this central shrinkage and peripheral adhesion is as follows: After the filling has been sufficiently condensed with the canal



42 43 44

Figs. 42-44.—Fig. 42, mesial root of lower molar showing a beautiful webb perfectly infiltrated with gutta-percha; there is a filled accessory foramen in the exact center of the distal surface of this root. Fig. 43, radiographed in the mouth both of these canals would show that it was filled perfectly; examined under glass, lingual canal shows seven foramen, only one of which is sealed. Fig. 44, divided canal of lower central; both perfectly filled with one gutta-percha point by diffusion.

pluggers, select a plugger of suitable size, and by passing it down thru the center of the filling for at least half the length of the canal entirely break up all central cohesion.

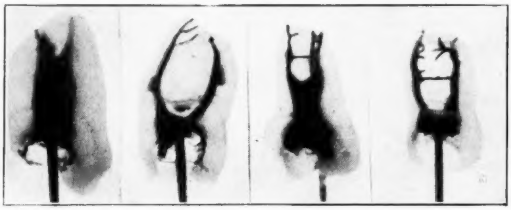
The pulp chamber should then be quickly filled with cement so as to prevent external evaporation of the chloroform, for if the chloroform is permitted to evaporate externally, even the above precaution will not prevent peripheral shrinkage.

Nothing has been said so far about the effectiveness of the resin in filling the tubuli. Chloroform is one of the most

penetrating liquids we have and it not only quickly penetrates the tubuli, *but the inter-prismatic spaces* between the enamel rods as well. This can be easily proved. Dehydrate an extracted tooth either by allowing it to dry out or by a protracted immersion in alcohol or acetone, soak it for several hours in a rather heavy chloro-resin solution, then try to break the enamel with a chisel or by grinding with a coarse stone. An old tooth which has been dried out for years, and the enamel of which is as brittle as glass, can be made as tough as a fresh tooth in a very few hours by this simple process. This is an excellent way to treat your technic teeth so as to prevent the chipping off of the enamel while you are preparing them for various uses and also to prevent their cracking and checking in after years.

Of course, if this solution will carry sufficient resin into the inter-prismatic spaces to have this effect on old, dried-out teeth, there can be no argument about its carrying sufficient resin into the infinitely larger tubuli to effectually obliterate them and encapsulate in its dense, solid substance any bacteria they contain. Even granting (as some contend) that the resin is not a germicide or antiseptic, a bacterium encapsulated in it has about as much chance to functionate and proliferate as the proverbial snowball has in the southern seaport town usually mentioned in connection with it.

Before I terminate this part of my paper, I wish to refute a statement contained in an article which appeared in the September *Cosmos,* to the effect that a pulp-canal filling made by the Callahan method could not be shown by the X-ray. This is totally erroneous, as will be shown by every one of my illustrations. The writer states: "The radiogram showed the filling as far as the cone penetrated but did not show where the solution of gutta-percha had filled the canal." If his Callahan filling had been properly made there would have been nothing but a heavy "doughy" solution of gutta-percha in the canal—no cone left. That there is a great difference in the radio-shadowgraph of an extracted tooth and one in situ I admit, but laboratory findings must always be correlated to clinical findings.



45 46 47 48

Figs. 45-48.—Fig. 45, distal root of lower molar; the supernumerary canal shows one large and two small foramina. Fig. 46, distal and lingual roots of upper molar. Fig. 47, fused distal and lingual roots of upper molar showing a small webb, three communicating canals and several blind canals. Fig. 48, most unusual canal anatomy; distal and lingual roots of upper molar fused; distal root extremely curved, with two large foramina and two blind canals; large communicating canal and lingual canal with two blind canals and a semicircular canal; this specimen filled wet, using mouth technic; it would be impossible to fill these minute and torturous canaliculi without invoking the aid of the law of diffusion; specimen rendered highly transparent by bleaching.

PART II

A Definite Treatment of Periapical Infection

For several years I have consistently used ionization immediately before filling the canals of all infected teeth, and even the old zinc chloride has given some remarkable results. But for the past several months I have been using a solution of iodine for this purpose which has given results far exceeding anything I have ever been able to get before. This solution is simply the old-time Churchill's tincture of iodine. It is highly electrolytic and has a high iodine content, 16½ per cent. The formula is as follows:

Iodine	165 gm.
Potassium iodide	33 gm.
Water	250 mm.
Alcohol (q. s.)	1000 mm.
Mix	

I have not been using this long enough to prove it out on the streptococcic infection but in the staphylococcic type it gives almost instant results. I now have records of forty-four cases of periapical abscesses with sinus and in every case save one the formation of pus ceased immediately after fifteen minutes ionization with this solution. In the great majority of these cases the canals were cleaned out, ionized, and filled at the first sitting, and in no case except the one mentioned was there any after soreness or discomfort to the patient.

Case 1.—Girl, age thirteen; right lower first molar; abundant flow of pus from both roots persisting for over three months in spite of treatment by several good dentists. Could not be sealed for more than an hour. Ionization with zinc chloride gave no results.

Treatment.—Pus removed with dioxygen, Churchill's tincture of iodine pumped into those canals, zinc point placed in each canal and all of them ionized at the same time. Current on for fifteen minutes giving one-half milliampere for each canal or a total of one and one-half milliamperes. The pulp canals were then filled immediately by the Callahan method. The following day, when the patient returned, she reported that there had been absolutely no pain and the tooth perfectly comfortable at all times and capable of mastication.

Case 2.—Boy, age fourteen. History showed an acute abscess four months previously on left lower first molar. No treatment given at that time. Copious flow of thin, light yellow pus. Treatment and result identical with case No. 1.

Case 14. (cited because it is the worst case of its type I have treated).—Woman, age about twenty-five; upper right bicuspid, very ugly sinus of five months' standing on the buccal gum. Treatment same as other two cases quoted, except that as this tooth has only two canals it was given a total of only one milliampere. Twenty-four hours later the sinus was *entirely* closed, only a white cicatrix remaining. No after pain nor soreness. (Most of the sinuses close in twenty-four hours.)

Case 39.—Boy, age eighteen; upper right first molar; condition exceptionally foul; small quantity of pus of the heavy, viscid type. Treatment the same as previous cases. Patient returned in afternoon of the same day, suffering acutely. Tooth was extracted and in the mesiobuccal socket was found a large opening in the antral floor. (Radiograph is often deceptive in regard to this.)

Case 41.—Lower right bicuspid; purescent. Treatment as above. Result: Entire relief of pain and no after soreness whatever.

Up to the date of this paper a total of forty-four cases have been treated as outlined above, and in forty-three of that number the flow of pus and formation of gas have been stopped successfully, leaving the tooth entirely comfortable and immediately serviceable.

Just exactly what this means from a bacteriological viewpoint, I will not at-

tempt to say, except that to stop the flow of pus and produce total closure of the sinus in such a remarkably short time certainly is strong evidence of the complete destruction of pus and gas bacteria. If it will destroy these bacteria will it also sterilize a granulomatous area? That remains to be proved. I may say that from experiments already finished, or under way, I am convinced that it does but am not yet ready to make a positive statement to that effect.

Discussion

Dr. John P. Buckley, Los Angeles, California: In the presence of the best dental histologist the world has ever produced, who will follow me in this discussion, I shall not discuss the histo-pathology of the subject under consideration, tho I fully recognize its significance and realize we must all give more attention to this phase of the work. I could easily spend the entire evening arguing on the nonessential points of Dr. Hinman's and Dr. Johnston's papers, but this is the day when time is too valuable to discuss and argue over nonessentials.

We are interested today in that bigger, larger problem of whether or not, in the conditions portrayed, we are justified in making any attempt to do the work so beautifully depicted and so beautifully illustrated by the essayists. I believe we are, and it is to the consideration of that larger problem that I wish to direct my remarks.

I want to mention briefly two things in which I differ, and then I will forget all about it. A seeming nonessential is this: I would hesitate to seal any acid, especially sulphuric acid, in the canal of a tooth, and I have honestly supposed that ionization was as dead as prohibition. It will not be long until the ionic outfits that are in your offices today will be just as much the objects of curiosity and sadness as are the cataphoric apparatus with which you were familiar in the past. But if any of you want to go to the unnecessary trouble of resorting to ionization in these cases, if you can get the excellent results that are shown here tonight, I will not take one minute of your time to discuss the methods by which these results are brought about. Rhein can show you equally good effects by the use of sodium and potassium with or without ionization. I believe Rhein gets his results in spite of his ionic medication, and when I discussed this subject with him in Milwaukee he said, "I don't know but what you are right." In order to stimulate your interest in this work and show you it is not necessary to ionize, I will exhibit some slides showing the treatment of these cases by an entirely different method, but a method which I have advocated for years, and with which I know this audience is familiar. [Here Dr. Buckley exhibited several slides showing the filling of multiple foramina and of bone regeneration.]

I would like to emphasize many points in these two excellent papers; but I will only elaborate on the statement Dr. Hinman made about the use of these medicated root-canal pastes.

Some years ago I read a paper on "Whither Are We Drifting in Dental Therapeutics?" before the old Chicago Dental Society, prior to the amalgamation of that society with the Odontographic. It was about the time that dentists were accepting the statements of the manufacturers of these celebrated pastes which read, "Cure Them Quick," "Knock Them Stiff," "Cure While You Wait," "Permanently" and other catch phrases. Some day, I hope, in the not far-distant future, some one will have the courage to read a paper on "Whither Are We Drifting in the Removal of Pulpless Teeth." Let me tell you this: I will take the root-canal fillings made thirty years ago by Edmund Noyes, J. N. Crouse, Charles P. Pruyn of this city, John and Frederick Stephan's father, of Cleveland, long since dead, N. S. Shields, of New York, and fifty or sixty or a hundred of the men whom I know personally and back them against any of the root-canal fillings made today. One reason why dentistry has suffered was because young America accepted the statements of these manufacturers of root-canal pastes. They were told that if they put a little of this celebrated paste in a canal and inserted a gutta-percha cone they could go on and sleep, and all their ills would be well, and they believed it.

When I look over this audience and think of the progress that has been made in dentistry in every branch —removable bridge-work, inlays, surgery, conductive anesthesia, *et al.*— I am proud to be a dentist. But I want to say, in connection with conductive anesthesia, that this method of using local anesthetics, as taught all over this country by Arthur E. Smith, Richard H. Reithmuller, and others, is a great blessing to humanity, but as practiced by hundreds of dentists today in combination with curettes is an absolute curse. (Applause.)

Have you ever heard Gilmer, Brophy, Logan, Black, or Hinman, leading oral surgeons, demand the extraction of all pulpless teeth? No. It is largely young America again. In many instances it is the men without a broad knowledge of histology and pathology that are extracting all of these teeth and curetting the entire process around the infected area.

If I had a plea to make to you gentlemen whom I consider my friends I would not ask you to hesitate a moment to follow the methods outlined by these two gentlemen tonight. Where we have made the mistake is in quibbling over methods. Rhein wanted you to follow his technic, and Callahan wanted us to follow his technic, and several of us have introduced a technic of our own and have stood by it thru the years. Perhaps we are to blame for not getting together and adopting a standard or agreeing on some one method that the average man could use. But whether we were to blame or not matters little, for a determination will be made in the not far-distant future, and I believe you are convinced tonight, if you were not convinced before, that the retention of pulpless teeth in many instances is not detrimental to the patient's health. I would not hesitate in regard to a mouth containing five or six or eight or ten pulpless teeth, the canals of which were badly filled. I would perhaps take them all out, and perform alveolectomy if necessary. I do not care what you do as long as you do not go too far. When you get cases like those of Dr. Hinman and Dr. Johnston, and I believe I may include myself, it is a different proposition. If you are willing to accept clinical and X-ray evidence, the best evidence we have today, I feel that we have proved that many pulpless teeth, properly treated, may be retained in the mouth without being a menace to the health of the individual.

Dr. Frederick B. Noyes: Dr. Hinman began by saying that he and his associate were making a purely clinical presentation; that it was not scientific. I think it is the most truly scientific paper I have listened to in many days.

There is no distinction between the laboratory and the chair or the bedside with reference to scientific procedure. Many things reported from the bedside and the chair are utterly unscientific, and many things reported from the laboratory are utterly unscientific. But of all the places for truly scientific work the chair or bedside is the most difficult place, and when a man presents such a perfectly clear scientific recital of clinical evidence, it is the acme of scientific work in my opinion. In the laboratory you eliminate all but your governable conditions, so that you may work out one factor at a time. At the chair or the bedside you must take into consideration all of the facts that are present, and if you do not you are not proceeding upon a scientific basis. When in diagnosis a man proceeds upon a definite, clearly thought-out inclusive and exclusive method, he is therefore working in a most difficult, a most important, and a most valuable scientific part of medicine or dentistry.

I was more than interested in both of these papers, and I have never heard a clearer, more logical presentation of a technic of root filling. However, I want to remind you that the whole problem is a vital one, and I agree perfectly with the last speaker that there may be other ways that may accomplish the same results, but the vital problems are the same, and the results are successful or unsuccessful in proportion as the vital conditions are grasped and met.

There is one expression that has been common in the dental profession and is still common, both in the dental and medical professions which should be eliminated from every man's vocabulary. Pulpless teeth are spoken of as dead teeth. That has been a feature of more trouble to the human race in the last ten years than any other one expression. I received a letter not long ago from a man in San Francisco who said that I said in San Francisco that when a pulp was removed from a tooth it became a dead tooth. I did not say anything of the kind. What I did say was that when a pulp is removed from a tooth the dentin becomes dead dentin or necrotic dentin exactly the same as necrosed bone, and the only reason for a tooth's being maintained in the mouth is because the dentin is entirely covered with another tissue whose nourishment is not dependent upon the dentin, and whose vitality is not affected. That was the statement I made in San Francisco. That is the statement I make in my book. The maintenance of a tooth from which the pulp has been removed is dependent upon the maintenance of the vitality of the cementum, and it is very significant that from the very beginning of the formation of the root of the tooth the dentin is formed from the outside surface inward and is nourished from within; the cementum is formed on the outside surface of the dentin and is nourished from without. Thus dentin is entirely enclosed in this tissue whose vitality is not dependent upon the dentin. I make that statement without any qualification, and I do not believe there is any qualification, but in justice and fairness it must be said that we have not as yet any direct laboratory evidence as to whether there is any effect upon the cementum by the re-

moval of the pulp. We have a great deal of valuable clinical evidence, but no one that I know of has ever made sections of the roots of teeth from which pulps have been removed and compared those with sections of the particular root from which pulps have not been removed to see if he could determine any change in structural elements. However, some one ought to do it just to prove it, but no one is justified in making any such statement, because there is no evidence except clinical evidence.

I was very much interested in Dr. Hinman's showings of the kinds of reaction in bone, perhaps more so because a number of years ago in a very informal report of some work done for the institute I showed two distinct kinds of bone reaction, that is, a rarefying osteitis and a condensing osteitis, as shown from the pathologic specimens. Those conditions would certainly show in a radiograph if correctly made, as Dr. Hinman has shown them.

The whole problem is a vital, biologic one, and I have never been able to see any reason why we should suppose that a tooth was entirely different from anything else. If the vital conditions are met, there is just as much reason to expect restoration of normal arrangement of tissue in the peridental membrane and around the apex of a root as anywhere else, and all of the evidence of laboratory work that has come under my observation has tended to confirm it. I have never believed in the idea of wantonly enlarging the apical foramina or purposely forcing gutta-percha beyond the apex of the roots. I have often felt that nature had been very good to the dentist in the arrangement of the apical conditions for instead of being a disadvantage the number of apical foramina is an advantage in the technic of the perfect performance and the protection of the tissues beyond the apex. Certainly, from a biological point of view, if those multiple foramina can all be closed, it does not make very much difference what is in the rest of the canal or whether there is anything. On the other hand, unless all of these spaces are closed, there will always be an area of danger, and still I have a great deal of faith in the ability of tissue to react even under comparatively unfavorable conditions. Why should you suppose that a big area of necrotic tissue in some place in the body can be taken care of, absorbed, and removed and the area filled up, and a little microscopic, insignificant bunch of tissue because it happens to be around the end of the root cannot be taken care of? Certainly the tissues are no respector of persons, and they will react in accordance with the laws of health just as much in the peridental membrane and around the apex of the roots as they will in a plant. But there are more dangers and more possibilities of infection in the tissues which we have been considering than we have realized. I mean by that that there is more danger of infection passing from the mouth cavity than we know of. In the last two years I have been studying the lymphatic system. It is its duty to guard against infection of the system, and in no place in the body is the lymphatic system as highly developed as in the mucous membrane of the mouth. The vessels are not for the purpose of spreading infection, but for the purpose of picking up the infection that is present and destroying it.

The dental profession, at the present time finds itself in this position: Unquestionably in the past many, many teeth have been preserved that were a menace to the health and that finally caused the death of the patients. Unfortunately the dental profession as a profession has been more interested in the teeth than in the health of the individual. On the other hand, there are at the present time thousands of teeth being extracted which should not be extracted, which should be saved, and which never would be a menace to the health of their owners if properly treated. In every profession there will always be some men in whose opinion the public exists for the benefit of the profession, and there will always be some men in every profession who look upon their calling as existing for the good of the community, and the way this problem will be handled finally depends on the fact that in the dental profession we still have a majority of men who look upon their calling as a service to the community. (Applause.)

Dr. Hinman (closing): I am very glad to have heard Dr. Buckley's remarks. But while he does not believe in ionization, we do. There is one thing certain: We have gotten results by ionization just as Dr. Buckley has by his method of treatment, and I hope he feels the same way about us. I do not care how you fill root-canals so long as you fill them right. You can leave out chloro-resin or put it in. If you pour liquor into water you spoil the water. Thus the use of chloro-resin solution may not be such an important factor at all, but we believe it is the most important factor. However, Dr. Johnston and

I want you to try the method we have described. Callahan has shown clearly, by microscopic slides that by staining the chloro-resin it penetrates and fills the tubuli. We have repeated the experiments shown in the series and we believe that this is a fact, and that the tubuli are hermetically sealed. Dr. Buckley arrives at the same conclusion in a different way. The crux of the situation is this: If Dr. Johnston and I are able to get results by the method outlined, you should be able to get the same results by following the same or a similar technic. If what we have said tonight will arouse you men to think a little for yourselves, we will have accomplished something. A great many people think they think, but few people think. We want you to realize that the object of our coming here has not been entirely to teach you the technic of ionization, but our sole aim is to get you to help us in some small way to prevent the ruthless, murderous, radical extraction of teeth. If we can achieve the least bit of success in stemming this tide which is going on all over this country, we shall have succeeded in greatly benefiting mankind directly and the profession secondarily.

Chicago is looked upon all over this country as the greatest dental center in the world. The older men have made it that. The time is coming when they will not be so active, and it is going to devolve upon the young men to carry on the good work. I want you to think of what Chicago is going to be fifteen years hence. It is to be hoped that the young men will take up this work in a scientific way, thus taking up the burden of the older men of making this city the dental center of the world.

Dr. Johnston: The tone of this discussion has been wonderful, it has been a revelation. We have tried in our little way down near the corner of the bean patch to work along lines that we believed might result in the greatest good to the greatest number, and those little results, incomplete as they are, we have presented to you. If any of you can gather any good from them we are more than delighted. If you are getting entirely satisfactory results with anything that you are using, you have attained a degree of perfection that is seldom attained in this life. If we are not endeavoring to improve in everything we do, I think our skulls are like that of the average darky—"ossified plumb solid." That is our exact position. We realize that we are far from the ideal. Ionization may pass away. We sincerely hope it will if it will be supplanted by something better. Our personal experience has simply been that we have obtained better results with ionization, particularly since taking up Churchill's tincture of iodine, than with anything else we have used. If you can get as good results without ionization you would be foolish to use it. Find out what gives you the best results and experiment more, for only by the process of elimination can we eventually attain any degree of perfection in our practice.

I want to thank the discussers of the papers for their courtesy. I have certainly found that Chicago hospitality and your courtesy are not surpassed by any section of the south, or any section of this country, and I think I might say any section of the known world. (Applause.)

THE CAST GOLD BASE

By HARRY E. HOLADAY, D.D.S., Kansas City, Missouri

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

THE method of casting gold bases as presented in this paper recommends itself to the writer because of the following advantages: (1) The time required is much less than that required by other methods; (2) a minimum amount of gold is required; (3) the duplicate cast is eliminated; (4) distortion of the mold is reduced to the minimum; (5) the disagreeable odors and smoke of burning wax are avoided, and (6) thru a simple technic, a smooth clean casting as beautiful as an inlay may be produced with gratifying regularity, despite the handicaps encountered in casting thin pieces which cover large areas.

It may be said of practically all methods of producing cast-swedged gold bases that they are superior to methods of swedging alone, because better adaptation may be secured, more beautiful designs are possible, and the construction of metal dies and counter-dies is unnecessary.

The *cast* gold base is especially indicated in all lower dentures and extremely difficult uppers. Preparatory to casting the gold base, the impression is treated in the same manner as for other bases, applying the separating medium, boxing, and pouring with Spence's plaster compound, except that the cast is made larger and heavier because of the stress that it must undergo in the swedging process.

After providing the cast with the necessary reliefs, it is ready for the wax pattern. These reliefs are cut according to shape and size required (No. 60 tinfoil), are burnished and then sealed to the cast with Alva model cement.

A sheet of clean paper spread upon the bench, a sharp knife, a wax spatula, an alcohol lamp or Bunsen burner, a pan of warm water, a wax wire forming device, together with a box of No. 28 and a box of No. 24 Kerr's casting wax sheets are required in constructing the wax pattern.

The cast is placed in the pan of warm water to become thoroly moistened so that the wax sheet will not adhere. A sheet of the No. 28 wax is also placed in the warm water so that it may soften slightly and thus facilitate adaptation. The adaptation of the wax to the cast may best be accomplished by pressing it to place with the tip of the tongue, exercising care to avoid wrinkles or folds and to avoid stretching the wax. When the sheet has been satisfactorily adapted, the surplus along the margins is cut away with a warm sharp knife blade.

At this point it is wise to remove the unfinished pattern from the cast so that when finished there will be no difficulty because of sticking, which is a tendency of the wax, especially during the summer months. Regardless of exaggerated undercuts and other difficult conformations, the wax pattern is easily removed by placing the cast and pattern in a pan of water and allowing a generous stream of cold water from the faucet to play upon it; elevate the heel of the cast to

such an angle that the stream from the faucet will strike the posterior border and find its way under the wax pattern when by that law of physics—that a liquid exerts an equal pressure in all directions — the pattern is gradually lifted from the cast with the minimum of distortion. While the pattern may be

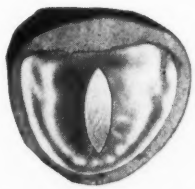


Fig. 1.—Spence cast. Relief in position, ready for the construction of the wax pattern.

slightly distorted in this process, the finished casting easily swedges to position and conforms to the original cast.

The pattern is reseated and the wax border wire adapted. This wire serves the double purpose of retention for the vulcanite and of a finishing line at the juncture of the vulcanite with the gold. The wax wire forming device is warmed

Fig. 2.—Wax wire forming device.

over the flame and several inches of No. 18 gauge round wire is secured. The operator, in placing this border wire, may exercise his artistic skill and, in large measure determine the beauty of the finished base. Further, the wire must be placed so that it will not interfere with the arrangement of the teeth upon the ridge. The wire is sealed to the pattern along the outside edge and smoothed with a hot spatula. This will leave an undercut on the inner side along the ridge, where it serves to retain the vulcanite. Additional retention is secured thru the use of pieces of No. 18 gauge wax wire cut into lengths of about one-sixteenth of an inch, attached at one end to the pattern while the other end is left leaning toward the border wire; these should be placed about 2 mm. from the border wire and about one-fourth of an inch apart, care being taken to leave the crest of the ridge free for the arrangement of the teeth.

The sprue is formed from a piece of No. 24 sheet wax sealed to the distal border of the pattern from tuberosity to

Figs. 3, 4.—Wax patterns of upper base, Fig. 3, and lower base, Fig. 4, ready for investing.

tuberosity. It should extend about three-fourths of an inch from the border and be shaped with a warm knife or spatula until the end is reduced to approximately half an inch in width. Additional sprue efficiency is gained thru the use of four No. 14 gauge wax wires extending from the main sprue, one leading to a point on each ridge in the region of the second bicuspid, one being attached to a central point in the palate, while the fourth follows the median line to a point of attachment on the anterior ridge. In case of the lower the main sprue is placed on the buccal border extending from the heel to the bicuspid region, while the auxiliary wire sprues extend one to the crest of the opposite tuberosity, one to the cuspid region on the side opposite the main sprue, while the other two

connect the lower lingual margins at points almost directly beneath the points of attachment of the first two. This arrangement is made with a view to taking advantage of lines radiating from a central source which will permit the molten metal to follow the lines of least resistance.

The completed pattern is now removed from the cast thru the use of a stream of cold water, as previously suggested. It is then ready to invest.

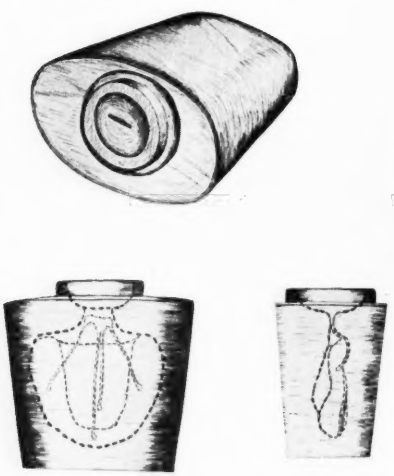


Fig. 5.—Flasks showing crucible and invested patterns.

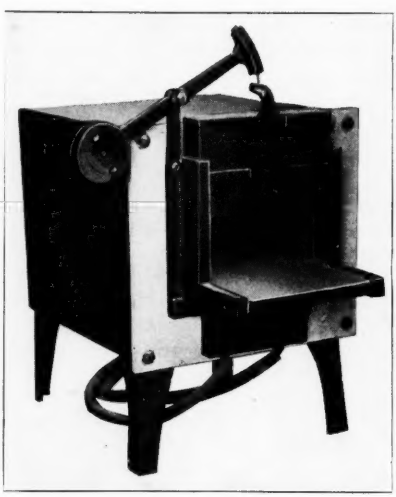


Fig. 6.—Electric furnace.

In mixing the investment, the required amount of water is poured into a large *clean* rubber bowl and the proportion of investment is sifted into this and spatulated until smooth. Grasping the pattern by the sprue, it is dipped and churned in the mix until it is thoroly coated with investment. The flask is filled and the coated pattern is then submerged to a depth which will bring the end of the sprue to the bottom of the crucible to be formed. At the end of eight minutes the crucible may be formed in shape to receive the metal and make an air-tight connection between the air bulb and the mold. At the end of an hour the investment is sufficiently crystallized; the flask is then immersed in a pan of boiling water and allowed to boil for fifteen minutes. This process dissolves and carries off the wax, leaving a clean and uninjured mold, without the annoyance of smoke and odor usually attending the burning out method.

Poor investment material is the cause of many failures. A good investment must be of fine texture in order to assure smooth castings and yet it must be porous enough to allow the escape of air; it must retain its integrity under high temperature and be able to withstand the impact of the metal against the walls of the mold. The following formula has furnished a satisfactory investment for gold bases, and it may be employed with equal satisfaction in the casting of inlays, clasps, saddles and bars, as well as for aluminum bases; it is inexpensive and the material easily obtainable. The formula is, three pounds of *good* cast plaster, four pounds of XXXX brand silex, one pound of fine white sand.

They should be well mixed and kept in closely covered cans. I find that by adding two ounces avoirdupois of investment to one fluid ounce of water a mix of proper consistency is obtained.

Investing flasks should be made of material thin enough to respond readily to the heat employed in the drying out process; a brass flask of No. 18 gauge made without laps is best. This will assure the minimum of contraction and expansion and lessen possible injury to the

Fig. 7.—Casting device.

mold and will permit the heat to penetrate to the investment readily and equally. A flask should be of such shape that the pattern may be best accommodated and yet avoid unnecessary excess of investment.

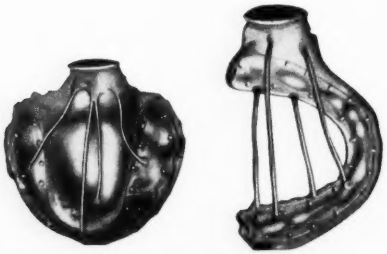
In drying out the mold, the Hoskins type F.D. electric furnace is employed. This furnace is large enough to accommodate the flasks and has sufficient heating capacity. After boiling out the wax the flask is placed in the furnace, which has been heated to 300°, and allowed to remain for fifteen minutes; then the temperature is raised to 600°, for another fifteen minutes. This period of thirty minutes is sufficient to drive off most of the moisture and obviate danger of explosion. The full current should then be applied and the base cast at the end of approximately thirty minutes or when a red glow has been produced thruout all parts of the investment; the base should be cast while the mold is as nearly as possible at this temperature. This method of applying the heat drys out the material as rapidly as is con-

Fig. 8.—Ready for casting.

sistent with safety, and at the same time does not retain the case at high temperature long enough to destroy the integrity of the investment. We have found that when large bodies of investment, such as required for gold base casting, are dried out at a low temperature until the mirror test shows no moisture, the mold will close enough to cause failure, therefore a high temperature must be employed to again open the mold to approximately its original dimensions.

The case is now removed from the furnace and supported firmly upon the bench while the ingot of 20 karat gold

(which has previously been heating) is placed in the crucible and heated to a white heat, using a Prestolite torch; the casting machine is quickly placed over the crucible and a steady equal pressure is exerted upon the rubber bulb for at least half a minute. At no time should the pressure be released during the operation. The casting machine is merely an automobile horn similar to that used in the Schweitzer casting apparatus. This horn is equipped with an outlet which, by the use of a layer



Figs. 9, 10.—Cast upper base, Fig. 9, and cast lower base, Fig. 10, after cleaning.

of moldine, may be connected with the crucible and made air-tight.

When the case has cooled the casting is removed from the flask, separated from the investment, and pickled. Then the sprue wires are cut off and with a jeweler's saw the main sprue and excess gold are removed.

With a small stone, pumice, a felt cone, brush wheel and "Tripoli" the casting is polished. The finishing line is produced after the cast has been polished, since further polishing would destroy the clean cut margin. This sharp margin is secured thru grinding the border wires to a well-defined edge.

The base is now placed on the cast and, if necessary, a preliminary adaptation, before swedging, is assured by the use of soft wood sticks and a horn mallet. In swedging, a six-inch length of water pipe, measuring five inches inside diameter, is fitted with a plunger made from hedge timber encircled about the top with an iron band; a one-inch

Fig. 11.—Swedging outfit.

layer of putty is put in the bottom, and upon this layer is placed the cast with the gold base; after covering this with a piece of cheesecloth, putty is packed about it and a layer an inch in thickness is put above it; the plunger is inserted and after gently tapping to place it is hit one terrific blow with a sixteen-pound sledge hammer.

The technic described above produces definite, dependable results to a greater degree of perfection than any other method I have known.

CLEANSING THE MOUTH

By C. EDMUND KELLS, D.D.S., New Orleans, Louisiana

REALIZING some years ago that a spray was a veritable camouflage, as far as cleansing the mouth was concerned, and that all it really accomplished was to wet the (already wet) mouth with a pleasantly flavored liquid, it occurred to me to try a *gentle stream*, using an antiseptic wash for the purpose.

It was my desire to get as clean a mouth as possible before undertaking the removal of an impacted tooth. Pursuant to this conception, a little *flushing machine* was made for the office, using from three to five pounds of air pressure.

Upon flushing out the mouth of a patient with this apparatus, the almost universal exclamation was, "Why Dr. Kells, my mouth has never felt so clean before." After repeatedly listening to this statement, I became so impressed that I decided to try it on myself. After doing so I too could truthfully say, my mouth had never felt so clean before, and that was not all of it, for I realized that I never had been so clean before.

This was a revelation to me because I had been under the impression that in view of the thoroness with which I used a wash, tape, brush, and dentifrice my mouth always had been pretty clean, but having been convinced to the contrary the next logical step was to devise a machine which I could use at home where I had no compressed air system.

A gasoline torch on a shelf in my workshop appeared to be a good starter. This was altered to suit the new requirements, as illustrated in *Oral Hygiene* for November, 1913 (Fig. 1a).

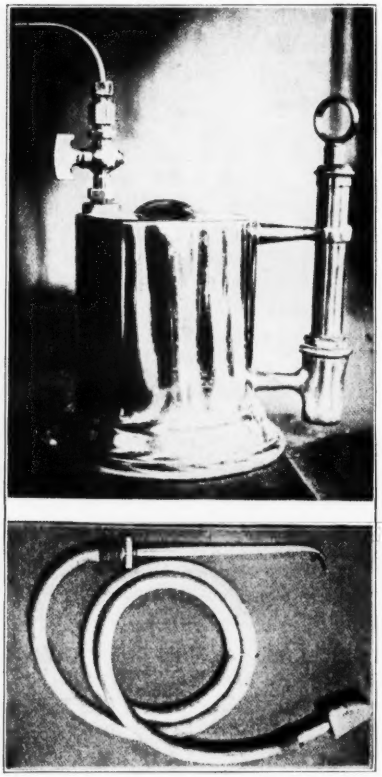
The use of this machine for a short while demonstrated the fact that if it was a good thing for me, which it undoubtedly was, it should also be good for my patients at home; but this torch had some inherent defects which should be corrected.

I realized that comparatively few people would be bothered with flushing out their mouths in this manner, but inasmuch as there would be a patient here and there who might do so, he should be furnished with a satisfactory machine. A new apparatus to accomplish this purpose was then devised for my patients' use. It consisted of a suitable five-gallon tank, which was found in regular stock, in the top of which a hole was cut and a screw stopper provided with a washer fitted in, so that the warm fluid for flushing could readily be poured in. A regular tire pump, a standard gauge, an ordinary check valve, rubber tubing, and a nozzle completed the outfit (Fig. 2).

In order to use this, the patient poured in about a quart of warm antiseptic solution and pumped in air until the gauge registered about five pounds. The machine was placed alongside of the bath tub, and the patient would *hang over the rim* and the water would flow from the mouth into the tub. I have had patients who used these machines regularly to completely transform the condi-

tion of their mouths. I would not have believed such results could have been achieved if I had not seen them myself. Few, however, could be induced to be bothered with this complicated process

a



b

Fig. 1

for flushing the mouth, and it was no wonder, for I had to exert myself to be included in the few and kept continually wishing for a simpler machine.

Up to that time the dominant idea was to use warm normal salt or ipecac solution or some antiseptic wash, but finally I realized that clear water was probably all that was necessary. Therefore, after all these years of experimentation, I sifted the process down to flushing out the mouth with clear water just as it comes from the tap, and thus we were relieved of a very troublesome machine. The new appliance consisted of a length of rubber tubing connected to the outlet of the bath supply by means of a cork and the little nozzle as before

Fig. 2

(Fig. 1b). This was also illustrated in *Oral Hygiene* (November, 1913).

However, this did not prove so satisfactory because it was difficult to seat the cork so firmly in the faucet that it would not pop out; another step forward was necessary. Very many bath tubs are fitted with Fuller combination faucets with one outlet, and this outlet is usually provided with a screw connection for rubber hose attachment. I took this screw connector and soldered an inverted *Y* into it. The *Y* was provided with

an outlet suitable for the attachment of three-sixteenths rubber tubing, and the tip was taken from a No. 22 S. S. White chip syringe (Fig. 3).

All that is necessary is to attach it to the faucet, with the open branch of the *Y* pointing toward the wall of the tub. Then turn on the cold and hot water slowly until a mixture of the proper temperature is made, with a pressure that will throw a stream the full length of the tub and strike the other end with some little force, which means that

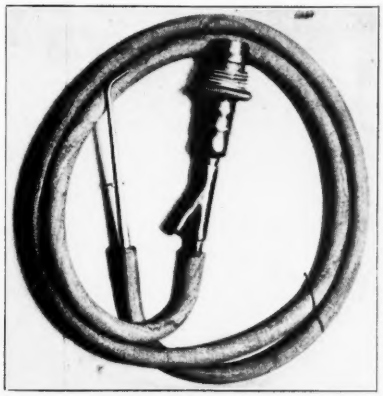


Fig. 3

the correct pressure is obtained for accomplishing the work. The open branch of the *Y* acts as a relief valve and is an improvement upon the original simple connection for the rubber tubing. Of course in warm weather water from the cold water faucet can be used.

With the water supply properly adjusted, both as to temperature and force, the user sits on a low stool or chair by the side of the tub and *hangs over the rim,* running the nozzle along the gum margin and up and down the interdental spaces both lingually and buccally. The soft, white deposit, which is frequently not removed by the brush, is rubbed off by the contact of the smooth end of the tip, while the jet of water completes the cleansing process. Then all the mucous surfaces are gone over, which gives a finishing touch to the operation.

That takes care of the process where there is this Fuller faucet, but a large number of tubs are provided with bell supplies. In those cases, we must resort to other means. As the faucets of washstands of the better class cannot usually be used, the following is the method suggested. The cold water supply should be opened up (under the washstand),

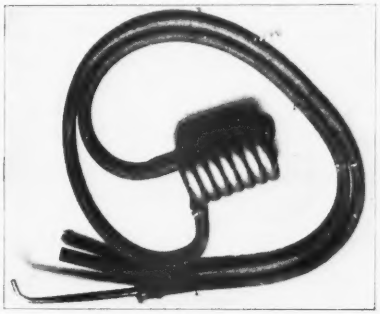


Fig. 4

a *T* placed therein, and a suitable valve attached, provided with a nipple suitable for three-eighteenths rubber tubing connection. This arrangement takes care of the situation as long as the temperature or ordinary tap water is comfortable. In the winter, a copper coil, made out of standard three-sixteenths O. D. soft copper tubing can be inserted in the line and the coil immersed in a vessel of hot water, whereupon a gentle stream of nice, warm water is obtained (Fig. 4).

For washstands of a different pattern, it would be possible to use rubber tubing large enough to slip over their outlets and by means of "reducers" connect the smaller tubing to them. Something of

the kind could readily be devised for any bathroom.

I can remember thirty or more years ago when my father gave to some patients regular dental syringes for rinsing out special interdental spaces, spaces which we would today call pyorrhea pockets, and I have a letter before me at this moment from Dr. G. V. Black (dated May 13, 1913) in which he says that he suggests to some patients the use of "our ordinary large bulb hand syringe that we use for water in the mouth" for the same purpose. Neither of these, however, appealed to me and their use never was suggested, but the idea of the stream was there.

The following extract from one of my papers might be a propos:

> The modern bathroom is fitted up in a more or less expensive style, while a couple of dollars spent for a toothbrush holder probably represents the total original outlay for cleansing the teeth and mouth. Some day, however, when the teeth and mouth come into their own, no modern bathroom will be considered complete without an appliance for flushing out the interdental spaces under pressure, the only possible manner of thoroly cleansing them, and the users of such bathrooms will devote the necessary time to oral prophylaxis and thus derive the benefit of its use.[1]

The devices just described (or at least the principle involved) are no longer an experiment, having been in use for ten years or more. They are extremely simple and quickly improvised. I wish that everyone who is really interested in oral prophylaxis (unfortunately all dentists are not) would make up one and try it out, for I am sure he would say: "Dr. Kells, my teeth have never felt so clean before." It is understood that this method of cleansing the teeth is to be used after the regular toilet of the mouth has been accomplished. It does not take the place of the brush or silk, but is used in addition thereto.

Several years ago, I learned that Dr. Schamberg of New York was working upon this same idea, but upon much broader lines. He proposed to furnish the public in general with appliances that could be carried from house to house, city to city, and adapted to any bathroom anywhere. Let us hope that he will soon carry out this purpose, because this would undoubtedly prove to be one of the greatest benefactions of the age.

[1]Western Dental Jour., August, 1915.

UNVEILING OF MONUMENT AND MEMORIAL TABLET TO FREDERICK HENRY REHWINKEL, M.D., D.D.S., AT CHILLICOTHE, OHIO

ON NOVEMBER 29, 1920, an occasion of unusual interest to the dental profession, took place at Grandview Cemetery, Chillicothe, Ohio, in the unveiling of a memorial tablet to Dr. F. H. Rehwinkel, as a preliminary event to the opening of the Fifty-fifth Annual Session of the Ohio State Dental Society at Columbus.

Pursuant to the arrangement, as announced in the program for the State Society meeting, a number of dentists met at the Masonic Temple, and at 2:00 P. M. accompanied by about fifty members of the Chillicothe Commandery No. 8, Knights Templar, under a special dispensation to participate in the occasion, proceeded to the grave of Dr. Rehwinkel, where, after properly assembling, exercises took place.

Dr. Charles W. Mills, of Chillicothe, president of the Ohio State Dental Society, spoke as follows:

Members of the dental profession and fraters of Chillicothe Commadery: We have assembled on this occasion to do honor to the memory of one who in life enjoyed a national reputation in our profession for his literary contributions and zealous activities in advancin the standards of dentistry. His private life was an exemplification of the principles of Templar Knighthood, and, for his zealousness in this Order, he received a deserved recognition by being chosen Right Eminent Grand Commander Knights Templar of Ohio, and in Scottish Rite Masonry was advanced to the 33rd and last degree.

As dentistry and free masonry were the subjects in which he was best known to his generation, it was deemed most fitting for this occasion to have an address, on his activities as a Mason and one on his activities as a dentist.

Assisted by Dr. L. E. Custer of Dayton, Ohio, Master Charles William Mills, son of the chairman of the meeting, unveiled the monument and tablet, the inscription on which is here reproduced:

FREDERICK HENRY REHWINKEL, M.D., D.D.S.
June 15, 1825—June 8, 1889
President American Dental Association 1877
President Ohio State Dental Society 1869 and 1885
Member State Board of Dental Examiners 1868-1889
President Miss. Valley Ass'n. of Dental Surgeons 1872
Captain Co. E 37th Ohio Volunteer Infantry 1861-1862
1st Commander A. L. Brown Post No. 162, G.A.R. 1881-1882
Rt. Em. Grand Commander Knights Templar of Ohio 1887
33° A. A. Scottish Rite, N. Masonic Juris. U. S. A.
His scientific and scholarly attainments; his moderation and self control; his quiet dignity and indomitable firmness, made a lasting imprint in every field of his activity.

The Ohio State Dental Society
Rehwinkel Dental Society
Masons of Chillicothe
November 29, 1920

Dr. Mills then introduced Mr. John P. McCune, of Columbus, Ohio, 33° Active and Past Grand Commander Knights Templar of Ohio, who spoke of "Rehwinkel and Masonry" in which he paid a beautiful tribute to the character of Dr. Rehwinkel, his activities in masonry and his zeal for the institution.

ADDRESS OF DR. EDWARD C. MILLS, COLUMBUS

Members of the profession and fraters of Chillicothe Commandery: In accepting the invitation to address you on "Rehwinkel and Dentistry," it was done with much timidity on my part, because I felt the inadequacy of words to express fully the reverence in which I have always held the name of Dr. Rehwinkel, and the inspiration his preceptorship was to me when I entered the dental profession.

As my address refers somewhat to his professional activities, I would ask those of the laity present to bear patiently with me thru that feature of it.

Instances are indeed rare in the history of a human life where such honor and recognition are given to an individual almost a third of a century after he has crossed the Great Divide as we are now paying to the memory of Frederick Henry Rehwinkel.

It is evident that the flight of years has not dimmed the luster of his achievements in those fields that were benefited by his activities. Our gratitude to him finds us on this occasion responding to that noble impulse, which, since time immemorial, has swayed the human mind to commemorate certain important events, or to do honor to the memory of some individual who has acquired certain fame in some line of activity.

Science and literature have added more imperishable names to the world's annals than any other endeavor, because these specialties contribute largely to human development, comfort, happiness, and those essentials upon which our progress and expansion depend.

The names that stand pre-eminent in dentistry were in the main, not those whose whole energy concentrated in their chosen specialty, but those who have been men of recreative diversion, and by indulging the various bents of their minds have, thru contact and association, rounded out to fuller possibilities and are accepted as better balanced and more widely informed men.

Few men have been so signally honored, both in the profession and out of it, none more modest in receiving recognition than Dr. Rehwinkel, and the tablet we have today dedicated to him shall mutely testify to coming generations that the name it bears was revered by his confreres and the recognition inscribed thereon should be an inspiration to them for more than ordinary attainment.

Association with him as a student soon caused in me a profound reverence for him as a man of high ideals with a mind versed in infinite subjects, which afforded him valuable relaxation from the stress of a busy practice. For example, entomology was one of his many diversions, and in the early spring he eagerly welcomed the strange and varied forms of insect life, which he studied with the enthusiasm of a scientist. His interest in scientific subjects was not his only means of diversion from the necessary cares of life. He was a great lover of nature and appreciated her handiwork, which was so fully lavished on the environs of the city of his adoption—for Chillicothe is so situated in the valley, with the beautiful hills surrounding it and the streams enriching her fertile plains, that one who had chosen the spot in which to live felt fortunate indeed; while those of us who claim it as the home of our nativity are well rooted to the place and feel a tender kinship for it—for the sounds and accents which haunt it; and the definiteness of early

memories are inwrought with affection and kindly acquaintance, so that one ever returns to partake of the restful spirit which pervades the place. He loved the call of the wild, and field sports were one of his many hobbies. His bird-dog "Queen" received the same lov-

IN MEMORIAM—FREDERICK HENRY REHWINKEL
Born June 15, 1825—Died June 8, 1889

ing care as a member of his household, and her almost human intelligence seemed to bespeak a loyalty to her fond but dignified master, in the pursuit of the one out-of-door sport which was perhaps to him the most alluring.

As an estimate of his attainments by one of his confreres in the dental profession—in the discussion of a paper read before the New York Odontological Society, April 17, 1877, on "Devitalized Teeth and Their Management"—Dr. W. H. Atkinson of New York, in his time dean of the dental profession, paid him the following tribute in opening the discussion:

> This is one of the very few papers that come before us entitled to, or able to bear severe criticism. The gentleman being well learned, is much more likely to lead us astray when he is in error, because of his clearness of statement where his statements are true, for the reason that our confidence is gained by the clear coincidence of our own judgment with the main statements in the paper; therefore we had better be a little cautious about accepting the whole.—[*Dental Cosmos,* XIX, (1877), 455].

In this paper he advocated the same conditions we are striving for today—

those that will make necrotic tissue compatable with the living.

Touching on his technic in root-canal work, I have recently received a letter from Dr. Howard Raper, a native of Chillicothe, now of Indianapolis, in which he mentions several teeth, the roots of which had been successfully filled by Dr. Rehwinkel as shown by an X-ray examination.

At a meeting of the American Dental Association in Chicago, 1877, as a report of the Committee on Pathology and Surgery, he read a paper entitled "Causes and Conditions Attending the Formidable Disease of the Gums and Root Membranes and Alveolar Process Known as Pyorrhea Alveolaris." In that paper he endeavored to establish "that pyorrhea may and does exist independently of foreign deposits, and that it does occur in the cleanest of mouths and must, for its origin, depend upon other than mere local causes" (*Transactions of the American Dental Association*, 1877; *Dental Cosmos*, 1877, p. 572).

In Black's *Special Dental Pathology* (1915) reference is given to the above paper, as follows:

> Dr. Rehwinkel's paper, in 1877, was by far the best writing upon this subject up to that time. It abounds in inquiry rather than in the discovery or announcement of the principles of pathology. It is rich in reference of both American and European authors. Altho it set a landmark in the name to which it gave origin, it did little to advance our knowledge of the disease. No hint is given of the pus pocket as such, or as a distinct entity in the pathology of the peridental membrane; the nearest approach to this idea is the mention of the peculiar form of calculus which occurs on the sides of roots where the membrane has been destroyed, and states it is sometimes different from salivary calculus; states many suppositions regarding systemic conditions as causative factors in inducing disease of this tissue.

In the *Dental Cosmos* for 1875 (p. 278), under "Hints and Queries," a condition of the gums is described, and a reply signed "J. T." states that the disease as described indicated it to be "pyorrhea alveolaris" of the French writers. Without inquiry as to the origin of the term now so familiar to the laity, full credit must be given to Dr. Rehwinkel for introducing the term into American dental literature and having called the attention of the dental profession to its seriousness.

Time did not permit the compilation of a complete list of his contributions to literature, but his writings were lucid and instructive and of great benefit to the profession.

A skillful operator, careful student, a strong advocate for efficiency in all its branches of practice, Dr. Rehwinkel was classed with and enjoyed the sincere friendship of such stars in the dental firmament as Atkinson, Taft, Watt, Butler, Keely, Webb, McKellops, Palmer, Black, and scores of other contemporaries.

A man of high ideals, he was ever alert to raise the standard of his chosen profession. He was active in securing the passage of the first dental law in Ohio in 1868, defended it when assailed, and served continuously on the State Board of Examiners, which this law called into existence, from 1868 until his death, when he was succeeded by Dr. L. E. Custer, of Dayton, Ohio.

Graduating from the Baltimore College of Dental Surgery in March, 1855, he prepared a graduating thesis on "Causes of Dental Caries." In this class of twenty-seven graduates are found the names of F. J. S. Gorgas, H. McG. Grant, and others whose names became well known thruout the dental world.

His activities in the Ohio State Dental Society were as varied as the officers and committees would permit: Charter member, 1866; second vice-president, 1868; president, 1869 and 1885 (being the only person twice honored with this office); member Board of Examiners, 1868 to 1889 inclusive; Board of Directors, 1888 and 1889; Committee on Membership, 1866, 1867, 1868, 1887, 1888; Committee on Ethics, 1868, 1869, 1872; Executive Committee, 1874, 1875, 1876,

1878, 1879, 1882, 1884; Committee on Dental Law, 1881, 1885, 1887, 1888; Committee on Patents, 1871; Committee on Constitution, 1885; Clinic, 1886 on "Herbst Method of Filling." He served as president of the old Mississippi Valley Association of Dental Surgeons in 1872. In national dental affairs he was no less active. Elected president of the National Dental Assosiation in 1877; Secretary of the Section of Dental and Oral Surgery at the International Medical Congress in Washington, D. C., in 1887, and president of Dental and Oral Section, American Medical Association, and would have presided at Newport, Rhode Island, June 25-27, 1889, had he lived.

In recognition of his dental activities, one of our most active of the component societies was christened in his honor as the Rehwinkel Society, at its organization September 18, 1910. He recognized early in his dental career the important and sustaining influence of association with members of his profession, for in them he found a community of interests which he could not resist. His membership in the various dental associations brought him in contact with men who were an inspiration to him, and he gave his hearty support to everything pertaining to the welfare of his profession. Of his contemporaries, or predecessors in Chillicothe, none, to my knowledge, were members of dental societies, or, if so, failed to get the stimulation that would give them anything more than a local prominence. The record of the results of Dr. Rehwinkel's activities are a strong contrast to those of the dentist, who, ostracizing himself from his professional associates, sinks into the proverbial rut which leads to ante-mortem oblivion.

Next to his profession, free masonry was closest to his heart, and in this he advanced to the highest grade—the only member of our profession having been honored by the office of Right Eminent Grand Commander Knights Templar of Ohio, and the first of three who had attained the 33° Ancient and Accepted Scottish Rite. The other two, also deceased, were Drs. Jas. A. Stipp, Toledo, and Charles R. Butler, Cleveland.

In the civic affairs of Chillicothe, he was well informed, but owing to his inclinations, his activities were naturally along educational lines. He was for several years a member of the Board of Education, serving as president of that body in the early eighties. Thruout his professional career he maintained that a high-school diploma should be the credential for admission of students to dental colleges, and it is of interest to note that the dental law in Ohio, making this obligatory, became operative thirty years after his death. It may truly be said of him that some of his professional ideals were in advance of his time.

In enumerating the activities of Dr. Rehwinkel, it may not be amiss to include some biographical notes that have been obtained from various sources:

From the church register of Neuenhausen, Celle, Hanover, Germany, is found that Frederick Henrich Rehwinkel was born June 15, 1825, and was christened July 17, 1825, in the house of his father, Yohann Heinrich Rehwinkel, living in the part of Celle now known as Altenhausen. The family of Rehwinkel still living in Celle have no record or traditional memory of the man whom we honor today.

When about twenty-three years of age, he was graduated from a homeopathic medical college in his native country, and because of the political troubles in Germany he emigrated to America in 1848. One of the number of young men who came to this country at this time, and who was frequently mentioned by Dr. Rehwinkel, was Carl Shurtz, who became a prominent member of our National Congress. A younger brother, to whom the doctor was greatly attached, having been stricken with tuberculosis, and to whom a sea voyage had been

recommended, came with him. They arrived at Baltimore but were advised to go farther south and went to Mississippi, where the invalid brother died a few months later.

Dr. Rehwinkel began the practice of medicine in Natchez, Mississippi, and afterward came to Cincinnati, Ohio, where he associated himself with one Dr. Ehrman, and they did much work during the epidemic of cholera there in 1849. Being advised of a promising opening in Chillicothe, Ohio, he located there in 1850, but not meeting the success he anticipated he moved to Portsmouth, Ohio, in 1851, where he associated with Dr. Zimri Hussey. In November, 1851, he married Mary K. Jones, of Chillicothe (who was born in 1839 and died in 1912). To them one daughter, Cora, was born, who still survives.

In December, 1852, he returned to Chillicothe, and in 1853, finding his tastes and inclinations more in harmony with the practice of dentistry, he began the study with Dr. Joseph Sanford, a pioneer dentist there, who died in 1864.

In 1854 he entered the Baltimore College of Dental Surgery. He often referred to the cordial greeting given him by Chapin A. Harris, dean and founder of the school, when the latter learned that he came from Chillicothe, only twenty miles from Bainbridge, where Harris' brother John had practiced medicine and where he and James Taylor, founder of the Ohio College of Dental Surgery, had both received their first instruction in dentistry. After graduation he returned to Chillicothe, where he soon built up a choice clientele, and practiced continuously until his death June 8, 1889.

Tho of foreign birth, his patriotism for the country of his adoption must not be omitted. The Thirty-seventh Ohio Volunteer Infantry was the third German regiment raised in Ohio and was recruited principally among the patriotic Germans of Cleveland, Toledo, and Chillicothe. Its organization commenced under the second call of Lincoln for 300,000 men, in August 1861; by October 1, seven full companies had reported and Colonel E. Siber, an accomplished German officer, who had seen active service in Prussia, was selected commanding officer. Dr. Rehwinkel, having assisted in organizing Company E of the Thirty-seventh, was elected captain. After a short term of service, principally in the Kanawha Valley, West Virginia, he was ordered home on sick leave, and on returning to his regiment he was so injured by the overturning of a stage coach near Gallipolis that he was obliged to use crutches for a year and had to retire from military service October 1, 1862.

During the excitement in southern Ohio, due to the raid of the Guerilla Chief, John Morgan, in 1863, he was colonel of a regiment of raw militia encamped on the land now bounded by Paint, Fifth, Caldwell, and Seventh streets in Chillicothe. Some of his own troops burned the bridge over Paint Creek, then but about seven inches of water, and started the cry, "Morgan is coming." He failed to come, however, and a few days later Dr. Rehwinkel marched his regiment from Athens, Ohio, to Chauncey, on the road to Ironton, and back, a distance of more than thirty-five miles, in one day. The weather was hot and the troops that succeeded in reaching Athens that night realized that they had covered some territory.

His relation to the Grand Army organization was to him a source of pleasure and pride, and from them the following record has been kindly furnished by A. L. Brown, Post No. 162: Enlisted September 1, 1861; registered October 1, 1862; captain, Company E, 37th O. V. I., 1861-62; mustered into G. A. R. December 2, 1881; first commander of the Post, 1881-82. In small

towns there prevails a spirit of comradeship which is not possible in the city. Perhaps by closer association, men learn to know one another more intimately, and here and there we find groups of friends of more or less prominence in the life of the place.

Here in Chillicothe at the time Dr. Rehwinkel was advancing in years, but still active in his profession, was a coterie of men who were held in high regard by the younger generation. They represented the various professions, the mercantile pursuits, and others of some literary attainment, and minds broadened by extensive travel. In fact, few other towns could boast of the type of men of such distinguished demeanor as were residing in Chillicothe at the time referred to. It was the custom of these gentlemen to stop occasionally at one of the stores opposite the old post office on Second Street, for discussion of current topics. There was no prearrangement in this, simply "drop in," purely incidental meetings, but prehaps the more enjoyable by reason of this. It was not town gossip that brought them together, nor a matter of simply idling away the time; it meant a very real companionship, an honest exchange of ideas and views on the issues of the day. Among these men were counted many who meant much to the real life of the town and who were not only prominent in the home circles, but who had made names for themselves in the wider fields of activity, and among them was the man whom we honor today, whose interest in all matters of this kind was keen and intelligent.

Dr. Rehwinkel was a big man among men, a personality which dominated, an intellect which attracted and commanded. He had a keen sense of right and wrong, appreciating always the motive prompting an action. He was generous, friendly, sympathetic, kind-hearted, and ever ready to help any who were in trouble. He had a sincere faith in things spiritual, believing that the life beyond held the fulfillment of all earthly promise, the completion of work begun.

My personal estimate of the man whom we honor today is that his eminence as a dentist, his usefulness as a citizen, his character as a man secured for him an enviable reputation; while the frankness, generosity, and nobleness of his heart won the lasting love of all who knew him.

Like flower-bloom and fragrant breath,
His life survives the touch of death.
So we turn from his grave with eyes undim,
To greet the new-born day—and him.

ADDRESS OF A. F. EMMINGER

Sir Knights, Friends, Brothers: It is not with a feeling of pleasure that I respond to this call to make a few remarks upon this memorable occasion, in honoring the memory of our departed brother and friend, but with a deep sense of sorrow. I deem it a great privilege.

It was my good fortune to know the deceased intimately, perhaps more intimately than any man in the profession of dentistry. From the first day of our meeting there seemed to spring up a mutual feeling of friendship and love. I was attracted to him, and he seemingly to me. Our likes and dislikes seemed to run in parallel channels.

He loved nature and lived close to it. He was passionately fond of field sports, the rod, dog, and gun.

It was our custom each year to spend the hunting season in the field with dog and gun. He maintained a kennel in Chillicothe (bird dogs and beagle hounds) and I one in Columbus. On Friday night it was my custom to run down to Chillicothe. Saturday was spent roaming over the hills and thru the valleys about his home town. Sunday was spent in social intercourse. If Sunday was bright and the sun shining we would take a walk and frequently find ourselves on Grandview Country Hill, on this bluff where his body now lies cold in death, overlooking Paint Creek Valley. He would exclaim: "Em, (as he called me) have you ever seen

anything more beautiful?" The following Friday night he would run up to Columbus, and on Saturday we would repeat our program. This continued thruout the hunting season.

Brother Rehwinkel was a big man among his fellow-men, a man of high ideals, a man of scholarly attainments, a man who had a high conception of right and wrong and who wanted to be considered a right-minded man, always looking upon the bright side of life. He had a keen sense of humor, could tell a good story and enjoy a good story, knew where the laugh came in, and was always doing his part in the domain of amusement and entertainment. He was a formidable adversary in debate—quick at repartee, caustic when occasion required. He despised hypocrisy and deceit; if he was your friend you knew it, and if he were against you you knew it—no middle ground.

In public life he would have been a leader and would have gone to the top, as was evidenced in his Masonic career.

All in all, Brother Rehwinkel was a big brainy man, of fine high attainments and tender-hearted as a child. He was attracted and attached to the younger men in the profession, always ready and willing to extend the helping hand and encouragement.

Well do I recall when in New York City, attending the National Meeting in 1881, Dr. Rehwinkel, Dr. George W. Keely, and myself were walking down one of the principal thorofares and I had remarked "how they happened to cast their *lots* in small places or towns" when a funeral procession passed by. Dr. Rehwinkel took me by the arm and said: "Look at that, do you know who it is? That is why I am too old to change, and I have the consolation of thinking when my time comes everybody in Chillicothe will know who it is, and as the funeral procession passed down the street they will stand on the sidewalk and say: 'There goes poor old Rehwinkel.'" I looked at him and there were tears in his eyes and in mine too.

In my early professional career he was my ideal and model and I felt I was a better man for my acquaintance and associations with him. Peace be to his ashes.

Mr. Richard Enderlin, of Chillicothe, representing the Grand Army, spoke of Dr. Rehwinkel's activities in the Civil War, eulogized his patriotism, and made a masterful plea for loyalty to our flag and our country.

INSTITUTIONAL DENTISTRY

By FREDERICK A. KEYES, D.M.D., Boston, Massachussetts

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

WHENEVER an individual is committed to the care of an institution, under state, city, or private management, it is assumed that he will receive every medical attention of whatever nature is deemed advisable by competent medical authorities. And no one would think of questioning even radical medical treatment if it were thought to be advantageous for the patient. Despite this apparently taken-for-granted proposition, we dentists are confronted by an actual work-a-day condition existing in our public and privately conducted institutions which is uncomplimentary not only to the dental profession, thru the non-recognition of the importance of its work, but to each of us as individuals of our profession, for laxity in educating the community relative to the seriousness of neglected dental defects. No class of people in any community should command as much attention as these poor unfortunates confined temporarily or permanently in institutions thruout the country. They are there often thru no fault of their own but because of a social system which is far from perfection. Our duty to them can no longer cease, as it has too often in the past, with the thought that they are receiving sufficient food and have a roof over their heads. Recent investigations have shown that even in the so-called well-managed institutions medical attention can be greatly improved. Dentistry more recently has begun to receive recognition. But this recognition has been slow in coming and scant in its application. One large institution for the insane here in Massachusetts, an institution with upward of fourteen hundred inmates, within a few months had neither a visiting dentist nor a resident dentist on its staff. An orphanage here in Boston, richly endowed and equipped with all sorts of frills and furbelows, had no dentist on its staff at last report. Most of our state institutions, it is true, have visiting dentists, but few indeed have resident dentists. Many of our orphanages are far behind the times, even with a visiting dentist handling the urgent situation. Why should these conditions persist year in and year out after the importance of dental work has been brought to the attention of the authorities? We dentists have been very lax in neglecting to convince the proper governmental agencies of the importance of the care of the teeth to the general health of institutional communities and lax in then working for the establishment of clinics in these institutions. This should be done by dental societies. For effectiveness, a group of dentists will obtain much better results than the individual efforts of a scattered few. When the matter has been properly presented, the well-worn excuse of lack of appropriation will not be accepted from the institution head who will be exposed as negligent of the best interests of his charges.

In order to illustrate the amount of work done and the enormous amount to be done I shall read you extracts from data which were furnished me by the last resident dentist, Dr. Power, at the Medfield State Hospital.

At the present time, when focal infection is the predominating topic of medical and dental discussion, the care of the teeth of insane patients must be considered very important. While the resident dentist does not boldly claim that abscessed teeth, etc., are the cause of mental disturbances, yet he does claim that the presence of these foci of infection may be a causative factor in augmenting mental disturbances. Ruthless extraction has not been practiced, but no hesitancy has been displayed in removing teeth which gave any clinical signs of being a possible seat of infection, or which were grossly irreparable. Many cases of empyema of antrum and acute abscesses have been seen. These have received immediate attention.

Great difficulty has been experienced, from a diagnostic viewpoint because of the lack of an X-ray outfit. The nitrous oxide oxygen outfit has been a great aid. This anesthetic has been administered approximately 150 times and has saved the patients a great deal of unnecessary suffering. In rare cases, when deemed advisable, root-canals have been treated and filled.

An enormous amount of prophylaxis has been done. The collection of salivary calculus in most of the patients' mouths would astonish the average dentist. After eating a meal, an insane patient does not clean his teeth with a toothbrush, or by rinsing the mouth; even the subconscious cleaning given to the mouth by normal persons by use of the tongue, lips, cheeks, and sucking of food thru the interstitial spaces is absent. Many of these patients after a meal, particularly the demented class, close their jaws, and the lips, tongue, and cheeks remain motionless until the next meal. The result is that three or four days after a thoro prophylaxis a thick film gathers around the teeth.

Pyorrhea is very prevalent and has been treated extensively in many cases with great success. Plate work, when done, has been greatly appreciated by the patients. Bridgework has been done when requested by patients' relatives.

His statistics are as follows:

Number of extractions	2,861
Infiltration anesthesia used	158
Conductive anesthesia	37
Gas used	114
Ether used	4
Number of acute alveolar abscesses treated	28
Number of cases treated for chronic suppurative alveolar abscess with fistula	4
Number of cases of pyorrhea	390
Number of prophylaxis given	1,104
Number of synthetic fillings	158
Number of amalgam fillings	479
Number of cement fillings	30
Number of exposed pulps removed by pressure anesthesia	18
Number of exposed pulps devitalized	6
Number of putrescent pulps treated	25
Number of root-canal fillings	49
Number of cases of empyema of antrum	3
Davis crown	5
Bridges { one 6-tooth	
Bridges { one 2-tooth extension	
Plates { full cases	17
Plates { partial cases	2
Number of plates repaired	19
Number of restoration for attendants (accidents)	3
Number of cases of stomatitis treated	14
One growth removed	

These facts from Dr. Power are self-explanatory. It is pertinent to ask, are our institutions properly equipped for the practice of dentistry? Are all these institutions able to provide first-rate living conditions for a resident dentist? Again, as to the matter of compensation allowed, are our institutions provided with the necessary appropriation so that an adequate salary for a first-rate dentist is available? From my personal experience, I think I can answer these queries with an unqualified No.

Let us compare the salaries of other employees at one of our state institutions with that of the dentist:

Superintendent	$4,500.00
Assistant superintendent	2,340.00
Senior assistant physician	1,680.00
Assistant physician	1,450.00
Pathologist	1,560.00
Dentist	900.00
Superintendent of nurses	1,074.44
Supervisor male side	1,074.44
Assistant supervisor	1,016.94
Assistant supervisor	1,016.94
Night supervisor	778.00

The stenographers and clerks also receive greater salaries than the resident dentist. A brief glance at the above figures indicates that the dentist is grossly underpaid and inasmuch as salary indicates the importance of the

work done, his work is greatly underestimated. I would suggest that in order to rectify this injustice, the resident dentist be given at least an equal salary with the lowest paid physician, and, furthermore, the resident dentist should have living quarters in keeping with the dignity that his position in life demands.

I think you will agree that we have great cause to be pleased with the amount of work done in the last five years:

Number of extractions	10,216
Number of acute alveolar abscesses treated	97
Number of cases treated of chronic suppurative alveolar abscesses discharging externally thru fistula	14
Number of cases of pyorrhea treated	461
Number of fillings inserted in carious teeth	1,112
Number of exposed pulps, removed by pressure anesthesia	56
Number of root-canal fillings	139
Number of cases of empyema of antrum	4
Number of plates (full cases)	77
Number of plates repaired	104
Number of cases of stomatitis	44
Number of prophylaxis given	1,871

From the above statistics it is evident that we dentists are at least trying to improve the mouth conditions of patients in our state hospitals.

After the enormous amount of work reported above was done, it would seem as if its beneficial effect on patients would be apparent in relation to general health. But owing to the slipshod method of keeping statistics we have not been able to make a definite comparative study. In getting the dental work on to a workable foundation we have met discouragement in the prevailing lack of system relative to indexing the physical condition of patients. After three years' effort, we have not been able to obtain data relative to the incidence of infectious diseases at the institution—a very important detail in attempting to arrive at a just estimate of dental efficiency. In general we can say that during the influenza pandemic Medfield had more cases than any other institution of its kind in Massachusetts, despite the fact that more actual dentistry was done there in the last five years than in any other institution. This is contrary to many reports of the value of dental prophylaxis against influenza. From this result it would appear that the condition of the teeth had no relation to the incidence of influenza.

Dysentery, which has been very severe in the institution, has been reduced to a minimum since the establishment of a fly-eliminating system. But may not the dental work be of some importance in influencing this? Lobar pneumonia is less than in any other institution with which the superintendent has been connected. The dental work, despite the lack of comparative statistics at Medfield, I am sure has influenced the health of the patients in many ways. Therefore I suggest to dentists undertaking similar work to be sure that statistics of infectious diseases are carefully kept so that the real value of their work may be supported by statistics.

The effect of bad teeth on mentally diseased patients has professionally received much publicity in the last few months, due particularly to the report of Dr. Cotton. Altho we have not followed cases as closely as Dr. Cotton, the superintendent at Medfield is inclined to believe that aside from comfort and increased health, there has been little, if any, change mentally in the patients. In fact, none have become miraculously cured, as Dr. Cotton reports.

Many well-meaning but radical physicians and dentists are doing a great injury to the importance of the teeth as a focus of infection by outlandish claims without enough scientific and clinical results at hand to justify their contention. That the teeth are a focus of infection in many cases we are bound to admit; also that an impacted tooth may mechanically cause nervous reflexes and thus effect the mentality is granted. But to claim that insanity is cured by extracting three or four or more teeth with

granuloma is without foundation. There is plenty of room for real scientific explanation of the exact relation of the teeth to physical as well as mental diseases without exploitation and exaggeration.

Discussion

William H. Leak, New York City: I heard the essayist make the statement that the dental profession is to blame because we have so few dentists in our state institutions and public institutions, and I believe from my own observation that that is absolutely the case.

The dental profession has been ultra-ethical in making known the terrible conditions resulting from lack of mouth care. We have considered that we would be criticized if we came out and publicly proclaimed the necessity for treatment for mouth care. We have been afraid that the men who advocated these things might be charged with trying to make themselves prominent, and that has kept dentists from insisting that our institutions should do more along dental lines. I am surprised that Massachusetts has only one institution for the insane—if I understood it correctly. In New York state we have ten or twelve institutions for the insane, and there are about two thousand patients in each. In our insane hospitals in New York state we have practically no dental work being done. We have a few hospitals where dentists visit perhaps for a half-day during the week and endeavor to do a little work. All of us who know how much time is necessary to take care of one patient know that one dentist on full time cannot begin to do the work which is necessary in an institution of two thousand patients. And in relation to the insane patients which the doctor has mentioned, as I understand it, the insane patient is subject to more dental defects and diseases than the normal-minded patient. That being the case, the subject should receive public attention in every state. It is absolutely necessary if the normal patient wants to keep well, that he keep his teeth in excellent condition. It is therefore more than necessary for an insane patient.

Then we have another class of patients, the tuberculous patients. Our most eminent authorities on tuberculosis for ten or fifteen years have stated that to properly take care of a tuberculous patient the mouth must be in a good condition. The statement was made a long time ago that the expert in tuberculosis could not properly treat, much less cure, a tubercular patient where bad dental conditions exist. The thing that the author of that statement had in mind is this, that the patient with improper mouth conditions cannot properly masticate. He had no thought of focal infection, but merely that he could not properly masticate and therefore was without hope of recovery. In the last two years the profession has given a great deal of prominence to the subject of focal infection and the medical man who has been thru many serious situations is inclined to believe that it is worthy of consideration. I think it has been established that a large amount of disease is due to focal infection, but we must not forget when we consider focal infections that there are a great many other systemic conditions caused by bad dental conditions. The filth of the mouth taken down the alimentary tract is bad in itself, to say nothing of the germ life in the mouth of the infection which it may cause. We could go thru several different lines of institutions, in our states and cities, and we would find that they are receiving practically no dental care. Early last week I learned that in New York state we have twenty-two inspectors of bees to see that the state has good honey, and we have only one man employed to see that we have good teeth. I believe that if the state can afford to pay the salary and expenses of twenty-two men on full time to take care of the bees, the state ought to also provide as many men to take care of the oral and mouth conditions of the people.

I believe that the medical profession is willing to have the dental profession come in to do this work, and I think that in so doing we want to establish ourselves on absolutely the same plane as the medical men. Of course, in the state institutions like hospitals, it is necessary that there should be the medical men, but the dentist who goes in should not be subject to two or three superintendents and he should receive a salary commensurate with those men.

G. C. Robb, Altoona, Pennsylvania: I have charge of the clinic at the sanitarium at Cresson, Pennsylvania, and am in touch with very many cases of this kind. In handling these cases I have about a thousand people to treat, and I find that the greatest trouble is to get help. We cannot get the hygienists, and it is hard to get dentists to work in a tubercular sanitarium. In our new legislation in Pennsylvania we shall be obliged to make some regulation in regard to that for the future. At the present time we are trying to devise some way to get ahead of it. But the bad feature in handling these cases, in most of these institutions, is that many come in there in bad shape. Our director, Dr. Turnbull, has said, in many cases that the difference between a man getting well and a man dying is an infected tooth. And if we can get the state only to recognize the condition as it should be, then we can get men, but I am afraid we shall have to develop a great many of our people in our own institutions.

We cannot ask girls to go to our penal institutions and the average girl does not care to work for tubercular patients She is afraid of them. In the tubercular institutions a large percentage of the attendants will have to be developed in the institutions. The girls in the sanitarium are bright and alert, but they are tuberculous, and the consequence is that they can work only four hours a day. They work four hours a day and when they start to slip they have to stop. Consequently I have six girls where I only need two.

In regard to the reformatories, the work will have to be done by the male, because the female will not do it. But in those cases the inmates need as much attention as the outside public. The only place where I can see that the girls can do their best work is in the schools and similar institutions. I am glad that Dr. Leak spoke so favorably of the tubercular situation. But we shall have trouble and it will take years before we will develop the work sufficiently to get a logical outline of what we need. (Applause.)

William Rice, Boston, Massachusetts: I was very much interested in Dr. Keyes' paper and particularly in his reference to the perhaps premature conclusions of some of the institutions which have the care of the insane. It seems to me that we should proclaim our disapproval of the ruthless extraction of teeth as a possible cause of insanity in any form. It is the practice today in some institutions to remove all suspicious teeth, and, if I am rightly informed, in many instances the question of suspicion is determined by the physician and not by the dentist.

During the past four years Dr. Fernald, the superintendent of the Massachusetts Home for Feeble-minded, has regarded the care of these feeble-minded children of sufficient importance to establish a clinic at that institution, and it is carried on by a resident dentist who is in charge of students from the senior class in the dental school. Ten students from the senior class are sent there during the entire period of the academic year, and altho no marked results have been obtained in regard to the mental condition of these children, yet Dr. Fernald regards it of very great importance in reference to their physical condition—it has greatly improved the health of these children to have their teeth properly attended to and the diseased teeth removed. The question of remuneration for the resident dentist certainly should receive further consideration, and I have no doubt that as soon as the importance of this work is established in the minds of the controlling authorities, we shall receive the proper recognition. (Applause.)

C. M. Kennedy, Des Moines, Iowa: I understand Dr. Keyes' opinion to be that we need more dentists and fewer oral surgeons; also more general practitioners and fewer oral hygienists. I agree with the first, but I think we also need more oral hygienists. (Applause.)

The seat of foci infection is to be found much more frequently around the necks of the teeth and in the fissures than in abscesses, and as a result the infection gives more trouble above the gum attachment than below.

Carl D. Lucas, Indianapolis, Indiana: Institutional dentistry practiced and promulgated by dental internes in state, city, or privately conducted institutions is undoubtedly an innovation in the realm of preventive medicine in a number of the states of this country, but in accord with our essayist the majority of such institutions, thru their governing bodies, have not been sufficiently educated by the dental profession to cause them to realize the importance of the relation of general disease to mouth infection.

Due to the fact that at present there is so much diversity of opinion publicly, as well as professionally expressed and published, plus the recollection of formerly proved delusionary fads in medicine, such as Emetine therapy for pyorrhea, salvarsan luetic cure proved by the Wasserman reaction, which medium of proof is so variable, the tonsilar smoke-screen of dentistry, and finally the oral sepsis rampant propaganda; all told, the medical profession, per se, has become reactionary in the acceptance of possibly a new preventive medical delusion, such as some of our unscientific members of the dental profession are trying to prove oral sepsis to be. Therefore these unscientific, pseudo-conservative dentists are to blame for the discredit which befalls scientific facts in oral sepsis.

"Facts, not personally expressed opinions," if adopted by our profession as a slogan, ruling from dental publications the unscientific verbiage of personally ambitious pseudo-scientific impostors, who are desirous of seeing their names in print in dental journals, would be one very acceptable way of clinching our dento-preventive medical arguments in the annals of the medico-professional scientific records. Let us eliminate the erroneous linguistic demoralizers of sane, scientific data and accept professionally nothing irrationally pseudo-scientific nor the "lame and impotent conclusions" of the fallaciously prejudiced conservatist.

We realize that this ideal, once established journalistically, would firmly implant our profession upon a laudable plane of achievement, but, like the medical profession, the dental profession is quite controvertible in many points under discussion. Therefore the ideal dental journalism is not only a remote possibility but a crying need of the day.

We are of the opinion that 99 per cent of our genuinely scientific investigators con-

cur in the fact that all pulpless teeth with incompletely filled pulp canals are not only infected, therefore foci of infection, but immedicable vulnus and a menace to human physical resistance. If the medical profession could derive their dental information from unquestionably qualified dental scientists, thereby avoiding the confusion of their deplorably untrained dental minds by coming into contact with misinformed, unscientific, dental propaganda of conservatism for causmatic reasons, regardless of the curtailment of the allotted years of the possessor of pulpless infected teeth, it would become a much less difficult task to get the recognition from these institutions for dental care of these unfortunate specimens of suffering humanity.

Dr. Power, former resident dentist of the Medfield State Hospital of Massachusetts, could have earned three and one-half times more money as a bricklayer, carpenter, or plumber, at the present scale of wages of these craftsmen, than his institutional salary. Such men as Dr. Power, with his educational attainments, who choose to sacrifice years of their lives for the sake of the elevation of the standard of their chosen profession, are real martyrs to a worthy cause and they are duly appreciated by their confreres, but the injustice and inequity of such a state of affairs should be condemned publicly as well as within the confines of our profession. Not only have such men spent their time, energy, and money, most frequently at a sacrifice to their parents, to acquire their educations, but in the service to the state, in the early part of their professional careers, when a year or more may mean so much to their future establishment in their practices, their salaries should be commensurate at least to their immediate needs, and above all, they should not be required to live even more poorly than when they were students in college.

Time and the education of the laity as well as the standardizing of our scientific knowledge will finally establish a status of equity in the matter of justifiable compensation for the services of resident dentists in our public institutions and we, nor the general public, can ever measure the appreciation of benefits accruing from the services of these dental altruists.

Personally, we are of the opinion that there has never been performed the ruthless extraction of a pulpless tooth; therefore "ruthless extraction of pulpless teeth" should be stricken from dental discussions and records. A pulpless tooth, being invariably an infected tooth, from a preventive subacute disease sequela standpoint, should not only be classed as a suspicious tooth but rather as a menace to normal, basic metabolic ratio.

Peridental prophylaxis as emphasized by Dr. Power is a very important procedure for these mentally deficient patients. One can well conceive the gasto-intestinal physiological disturbances which would unquestionably arise from ingestion of the fermented pabulum of food debris, loaded with highly cultured organisms from such an oral incubator.

However, we are not in accord with Dr. Power in the instigation of extensive treatment of periclasia for such patients. As he points out, it is extremely difficult to receive any co-operation from these patients even to the extent of inducing them to brush their teeth. Therefore we are convinced that teeth so involved should be extracted and the gross infection surgically removed, in this group of cases.

If bridge-work be constructed as a restorative measure for lost teeth for these patients, we are convinced that only removable appliances are indicated and we question even this class of work for the mentally defective on account of the element of danger to the patients from the ingestion of such appliances or the more precarious possibility of the pneumonic complications which might arise from small removable appliances becoming disengaged in delirium and aspirated into the trachea or bronchi.

The dental internist in such institutions should receive the co-operation of the medical department in the matter of records of the physical condition of patients before dental treatment and after the completion of such work. Such details would establish a rational logic for such work and furnish clinical data for the subsequent management of similar cases.

Contrary to the conclusions of Dr. Keyes' report, that mental conditions have not been relieved by the removal of localized infections in the periapical tissues, we contend that such psychopathic conditions as insomnia, neuritis, and psychoneurosis have been completely relieved for periods, in personal observation, ranging from one to eight years.

Possibly Dr. Cotton may have become profoundly enthusiastic and may have overestimated some of his case reports, but since Rosenau has conclusively proved the elective localization of organisms in brain, spinal cord, and nerve trunks of posted animals, following intravenous injections with the growth in ascites-dextrose broth previously inoculated and cultured from pus about the teeth, we feel positive that in the near future, in a definitely scientific manner, we will secure scientific data which will establish a definite relation between psychoneurosis and oral sepsis.

Clinical evidence has proved that many cases of dementia with delirium, dementia praecox, and epilepsy have been absolutely cured by the relief of pressure exerted upon branches of the fifth nerve, by the removal of unerupted and impacted teeth, thereby establishing a

definite relation between disturbed mental equilibrium and malposed teeth, thru neuro-reflexes.

Dr. Keyes: Dr. Leak has indeed flattered the good old state of Massachusetts when he said that he believed we had only one insane institution in Massachusetts. We have seventeen or eighteen institutions, and a great many insane people in them. And we have an interest in our insane people which is not exceeded by New York state. I think it is also true that they are safer from disease than the normal patient. I am not prepared to discuss the matter scientifically, but from my observation I should say that the life of the insane patient averages up to the life of the normal patient. Most insane patients attain the normal middle age, forty or fifty years. With regard to tubercular institutions, I have just concluded an examination in a tuberculosis sanitarium of about 300 patients. They have never had dental care. There was hardly a case that did not need work. We found 140 cases of pyorrhea. We saw old, decayed, putrescent roots and abscesses in the mouths of patients sick with tuberculosis, and nothing was being done for them.

Regarding girls doing the work, I did not understand what the doctor meant by "girls."

Dr. Leak: I want hygienists and cannot get them.

Dr. Keyes: As regards cases of abscesses and decayed teeth in our public institutions, dentists should first do all they can in eliminating the pus and relieving the patient from pain. I feel that our attention should be concentrated first on having the dentist put in his time and do this most important work rather than the hygienist.

I am very glad Dr. Rice informed you about Dr. Fernald and the feeble-minded home. I have been in correspondence with Dr. Fernald for several years, and he is very enthusiastic about the work there and his scheme of having a resident dentist on duty all the time, with ten students doing the real work, is a valuable suggestion for the accomplishment of this work and for handling institutional work at the present time.

Regarding the remarks made as to the health of the children, we all believe that the teeth have something to do with the general health. We have proved this many times. But focal infection does not explain it all. It is not a panacea for all diseases, but it helps, and that is as far as we can go. Therefore all this fad of extracting and curetting, sometimes into antrums, when there is no clinical indication for so doing, by the so-called "oral surgeons" who spring up overnight, is unnecessary. I am a D.M.D.; tomorrow I say to myself, I will be an oral surgeon, Oral Surgeon Keyes of Boston. No training is necessary, just the mere taking on of this latest dental misnomer. It has come to pass that a dentist has no professional dignity. To have professional dignity you must call yourself an oral surgeon. The telephone books are filled with them. These are the very men who are exploiting the dental profession. If they were confronted with a real surgical operation, as, for instance, an osteosarcoma of the superior maxilla which required the complete excision of the bone, would they attempt it? No. They would go to a general surgeon who would operate. I contend that oral surgeons as a class are a lot of charlatans.

What we really need in dentistry, and particularly in dentistry in public institutions, is the establishment of dental clinics, a return to the good old-time practice of extractions, fillings, and cleanings by dentists. Dental hygienists, oral surgeons, and the like are merely fads, and there is no place for them in public institutions.

SHOULD ALL PULPLESS AND IMPACTED TEETH BE REMOVED?

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(Read before the Illinois State Dental Society, March 22-25, 1920)

THIS subject will be discussed under the four following subdivisions:

1. A review of the opinions of a relationship existing between focal infections associated with teeth and systemic disease.

2. Definite statement of the essayist's opinon as to what he believes to be appropriate practice in the management of these cases until additional evidence is presented.

3. Is curettement always indicated when a tooth about which there is a chronic periapical infection is extracted?

4. Statements bearing upon the surgical management of these cases.

There occurs in dental and medical literature during the last three decades the frequent appearance of articles stating that a close relationship exists between chronic oral infections and certain systemic diseases. However, it was not until the appearance of the findings of such noted investigators as Drs. Miller, Poynton, Payne, Lambert, Hunter, Billings, Rosenow, Hartzell, Larson, Grieves, Vaughan, Gilmer, Moody and Duke that the members of our profession realized the seriousness of the relation existing between chronic oral infections and such systemic diseases as arthritis, neuritis, nephritis, the cardiovascular degenerations, neurasthenia, iritis and myalgia. Personally, I accept the basic teachings of these men upon the systemic effort of chronic focal infections and oral sepsis as being unrefuted by any group of clinicians and investigators of equal authentic standing. Having declared faith in the doctrine that chronic focal infections may be the cause of many serious systemic diseases, let us now pass to a consideration of

The essayist's opinion as to what he believes to be appropriate practice in the management of these cases until additional evidence is presented.

(A) In my opinion sufficient evidence has not been secured by either the medical or dental profession to warrant a discontinuance of the filling of all root-canals in teeth having normal supporting tissues if the size of these canals favors placing a filling to the apex—providing this is done under the rigid aseptic conditions as now practiced, unless the patient in question is suffering from some serious systemic disease that might be detrimentally influenced by even a temporary infection if one should occur at the apex of the tooth.

(B) Until the advocates of the rather universal filling of root-canals can present additional evidence of the permanency of controlling the infection beyond a treated tooth, it is my opinion one is not warranted in advising a patient to have the root-canal filled in a tooth about which exists a chronic periapical infection that has resulted in the destruction of the pericemental fibres. The only exception I would make to the foregoing statement (B) is where a pa-

tient has never suffered from a disease that might be influenced by a chronic infection, and the tooth is one that experience has taught us to consider a favorable risk for root amputation.

The results obtained in the operation of root end amputations by even our best operators have not been such as to make the conservative practitioner promise a patient that there is any certainty that he will retain such a tooth for a given number of years, or that it positively will be free from an infected area for any length of time. However, there is some apparent clinical evidence that infection is eradicated in a certain percentage of such cases; therefore, I have not abandoned root amputation entirely, but my records show I have only performed it twice in the last ten months and in both instances the patient was a woman and the tooth involved the superior central incisor with less than one-third of the root end affected.

With the evidence presented by our investigators and clinicians it would seem that the profession is not warranted to entirely discontinue the filling of root-canals, but we surely have passed the point where the dental profession can with justification fill all teeth having sufficient supporting structures to retain them comfortably in the jaws in spite of the fact the apex is denuded and is forming a portion of the wall of an infected field.

We shall now pass to the consideration of cases presenting with a number of pulpless teeth in which root-canal fillings have been previously placed and the patients seek advice as to their retention or extraction. For the purpose of discussion we will divide these patients into two groups.

GROUP 1

Patients suffering from some disease held to be caused or influenced by chronic localized infections.

If a patient is a sufferer from myo or endocarditis, a marked hyper or hypo blood pressure, neuritis, iritis, chronic nephritis, gastic or duodenal ulcers for example, I would advise the extraction of all pulpless teeth held to be positively involved with chronic periapical infection—but I would not condemn every pulpless tooth diagnosed by the aid of proper radiographs as containing perfect root-canal fillings and having normal pericemental and periapical tissues. However, one feels more safe in the presence of extreme systemic disturbances, which may be accounted for by focal infection associated with teeth, to demand removal of all pulpless teeth in spite of normal hemanalysis and even tho the radiographic findings do not indicate the presence of localized infection.

The pulpless tooth should be extracted without hesitation, if systemic symptoms held to be due to the presence of infection continue after you are convinced that all areas from which teeth have been removed have healed normally, and a competent diagnostician has assured you that to the best of his knowledge no other localized areas exist in the system.

GROUP 2

Patients held by competent diagnosticians as never having suffered from any disease or condition which has a relation to chronic localized infection—yet present with radiographs outlining small periapical rarefied areas about pulpless teeth.

It is this group that causes more anxiety than the one previously discussed, for the reason we have all had patients with a number of teeth involved with periapical rarefied areas that to the best of our judgment have existed from one-third to one-half the life of that individual. These patients give a history of never having been sick with any disease except those incident to childhood. In the management of these cases it has been my habit to explain that altho

they have been healthy and may remain free from disease influenced by or traceable to chronic infection, retention of these infected tracts must be recognized as a menace to their health. In spite of their previous history one cannot assure them there may not come a time when lowered resistance will occur and ill health of a serious nature be the sequence of the retention of these teeth; and the only safe course to pursue is to have them removed or the root ends amputated. An explanation should be made that the present belief would indicate it is impossible to fill or refill the root-canals of a tooth and permanently control the infection beyond the apex if chronic infection has resulted in the destruction of the pericemental membrane. They must also be informed that they accept the responsibility of any ill effects that may come to them from the retention of these teeth, and we should urge upon them the importance of frequent dental radiographs and physical examinations to ascertain at an early date any departure from normal that might have a relationship to these known infections. Additional aid will be found in making differential blood counts before you can even with reservation permit them to be dismissed without advising extraction. This opinion is based upon the findings in four hundred and fifty-six consecutive blood examinations for patients presenting at my office for consultation having reference to focal infection associated with teeth.

But for fear some might place too much reliance upon hemanalysis in a single case, permit me to report that in this series neither pronounced nor moderate anemia was found to be commonly associated with chronic oral infection. Pronounced anemia was found but three times. Leucopenia was more constant than leucocytosis in pyorrhea cases where the blood findings were abnormal. Leucocytosis was present in 90.3% of cases of periapical infection without discharging sinuses, but leucopenia did occur under the same conditions in 3% of the cases.

Let the foregoing be not misconstrued to mean that either leucocytosis or leucopenia is always present when a periapical infection without a discharging sinus is found—we had cases of chronic infection at root ends where the blood findings were normal if such evidence is needed, for naturally periods arise when the effect of the pathogenic bacteria and toxins is so slight that no blood change is manifested. But, since severe secondary infections could occur during this period, a focal infection, tho producing no characteristic blood change, must always be looked upon as a menace to the health of the patient.

Is curettement always indicated when a tooth about which there is a chronic periapical infection is extracted?

The necessity of a thoro curettement of certain periapical infected tracts found associated with teeth is a procedure that has been commonly accepted by oral surgeons who have written upon this subject in recent years; while the more universal curettement following the extraction of teeth involved with chronic infection is one that has come prominently before the profession within the last two or three years. This probably can be accounted for as a sequence of the rather infrequent occurrence of a tooth socket healing and leaving the old infected tract resulting in certain instances in the re-establishment of the original systemic manifestations complained of by the patient before the teeth were removed. That this may positively occur has been established by a number of careful observers who have opened into these unhealed areas under aseptic precautions and secured the original bacterial flora; furthermore, the patient has frequently had an exaggeration of the secondary involvement in the period immediately following this second curettement.

It occurred to me a short time before I left practice for military service in 1917, that we were in need of additional data as to the frequency with which these rarefied areas do not clear following extraction without curettement—also the frequency with which the sockets heal apparently normal to the most careful inspection over root fragments that were not removed at the time of original extraction. Therefore, for a brief time in 1917 and for the past ten months it has been my rule when seeking focal infections associated with teeth to demand that all teeth and tooth areas be radiographed to ascertain if bone formation has taken the place previously occupied by the socket or any rarefied area that existed beyond, and at the same time to learn if tooth fragments or impacted teeth are retained in the jaws.

I anticipated I would find evidence of former periapical rarefied areas quite frequently and now and then a root with normal appearing overlying soft structures, but the facts are as follows:

In reviewing the radiographs of 35 edentulous jaws, 560 tooth areas and 1024 areas from which teeth have been extracted, making a total of 1584 positive outline of infected tracts was only made out 11 times, while the number of roots found was 75, and imbedded teeth 73. From this small collection, one should not draw definite conclusions, but I feel one is warranted in asking those who advocate curettement of every socket involved with a chronic infected area, on what evidence they base the necessity of this procedure? I am also constrained to propound to those who not only demand the removal of the granuloma or cystic like membrane found at a root end, but the curettement of the entire bone wall beyond the soft issues—the question that if this is necessary for the regeneration of bone to fill in the rarefied area, why is it we do not find these infected tracts remaining more frequently after extraction of teeth without curettement?

From the foregoing discussion, I do not desire to convey the idea I believe curettement is never indicated, but I do desire to positively affirm that my experience and observation to date does not lead me to believe sufficient evidence has been presented to cause any operator to demand the curettement of every socket from which a pyorrhea or pulpless tooth is extracted. For the purpose of presenting more clearly the essayist's opinion as to when curettement is held to be unnecessary as well as when indicated, I shall first try to explain by words and then supplement with stereopticon illustrations of actual cases. The underlying base from which to decide for or against curettement is found, first in the condition of the patient's health, and second the extent and character of the rarefied area.

If the patient is so debilitated that you believe the reparative process is far below normal it would be fair to assume that curettement is indicated in the moderately sized and large areas, but it is my opinion that the smaller ones, even in such a patient, will clear off the infected process and heal without curettement. It would seem one could, with justification, state a granuloma existing to a degree equal to one-third the length of the root could be classed as a border line case or one demanding curettement, and as the involvement diminishes from one-third the length of the root, the frequency with which curettement is indicated decreases until we reach the point where it is not necessary unless the operator believes he is dealing with a dental cyst instead of a granuloma.

Having discussed when the indications might permit of the retention of the pulpless tooth as well as when removal seems demanded, and having found imbedded teeth and root fragments more frequently than unhealed rarefied

areas, the question naturally arises—what should be our action when impacted teeth or root fragments are found? With reference to tooth fragments that show infected tracts about them or that have healed in with normal appearing overlying bone and soft structure, it would seem to me one would be justified in demanding their removal for surely they can never be made useful and are without value and should be classed as unsafe to retain.

Whether one should always remove imbedded teeth when found has ever been a debatable question with me, yet I remove imbedded teeth when thought to have relation to systemic disease or reflected pain, but many have been left when radiographs outlined normal bone in close contact with all enamel surfaces of the tooth. In the presence of severe systemic diseases where all known localized infections have been removed without the expected benefit to the patient, I have felt it unsafe to leave even such a tooth in the jaws, as we are without sufficient evidence at this time to say that such teeth have not infected tracts about them even tho the radiographs show no rarefied areas.

Before closing this phase of the subject, I wish to ask the co-operation of those especially interested to assist in ascertaining if the systemic reaction is greater or less when these teeth are extracted and curetted or extracted and not curetted. I also seek data if there is a variance in the systemic reaction when the tooth is extracted and the curettement, if performed, is delayed for a period of five to ten days.

Statements bearing upon the surgical management of these cases.

Altho it is possible in certain instances to curette the periapical area successfully thru the tooth socket, one can always be more positive of results by opening thru the buccal or labial plate. When the involvement is small we are warranted in making a u-shaped incision thru the soft tissues overlying the field and reflecting the soft structures including the periosteum to expose the bone, then with chisel or bur, remove the intervening bone—and upon completion of the operation the flap may be returned and sutured into position. If the area is extreme the flap is not returned and sutured. Without regard to whether the flap is to be returned or removed, the next step after removal of the intervening bone is to remove the granuloma or cystic membrane found. When thought to be accomplished the field is dried and examined and if smooth white bone walls are found you may be sure you have completed your curettement. It is not necessary, in my opinion, to remove the surface of this bone cavity as has been recommended by some. As evidence that bone cavities go on to healing without the removal of the bone surface, I call your attention to the occurrence of complete bone regeneration, not only in the small, but in the abnormally large typical and atypical cysts found particularly in the body of the mandible. This occurs promptly even in cases complicated by infection previous to operation.

Access to impacted teeth lying deep in the canine fossa and erupting to the palatal of the lateral or central can be gained most easily, unless the tooth is in an almost horizontal position, by making a u-shaped incision on the labial and reflecting the periosteum back. With a bur or hand chisel, go thru the bone at a point above the lateral incisor until the impacted tooth is reached, then after identification a little more than one-third of the root is exposed and cut diagonally. The root portion can then be lifted from its bed. The next step is to dislodge the crown portion by enlarging the opening about the root to permit the crown to escape thru the opening. If difficulty is encountered in bringing the crown portion to the opening, a blunt steel instrument can be forced thru the interven-

ing bone on the palatal surface to the point of the crown, and either by hand or mallet force, the crown portion of the tooth will be carried up thru the labial opening. By this plan we do away with the necessity of leaving a painful wound within the palate.

This same procedure is applicable to teeth lodged on a horizontal line just above and to the palatal of the first bicuspid, providing there is space for the operation without encroaching upon the antrum. Of course at times an impacted tooth lies too far within the palate for the approach above the bicuspids or lateral incisor, then thru necessity we must enter thru the palatal tissues. Without injury to the large blood vessels, a large u-shaped flap can be lifted within the palate that will permit the removal of the tooth lodged in this area and then sutured into position if conditions warrant it. In certain cases the danger of secondary hemorrhage is too great to permit suturing the flap back into position thruout its entire length. In such instances it is appropriate to make an opening thru the flap immediately overlying the deepest point of the bone cavity and thru this, control your hemorrhage with a gauze pack which is to be removed in twenty-four to forty-eight hours and replaced if necessary. If you have been able to judge the location of the impacted tooth previous to making your flap, it will be possible to insert the gauze at the line of incision if needed to control the secondary hemorrhage. Unerupted teeth located in the mandible should be approached from the labial or buccal by preference.

Altho general outlines have been suggested for the management of patients presenting with pulpless and impacted teeth, I desire to emphasize the importance of considering every case as an individual one which demands thoro investigation before a decision can be reached as to the proper course to pursue, for the man who undertakes to cure human ills by rule of thumb will frequently go far astray.

In closing, the prophecy is here made that chronic infections associated with teeth will not be effectively managed until the dentist's education includes more of bacteriology and general pathology and the physician's knowledge of dental pathology is more comprehensive. But until this much needed state of affairs is attained, can we not agree with William Hunter, author of the term "oral sepsis," when he affirms the treatment of the lesions of strepto and staphylococci found in the mouth, throat, nose and accessory sinuses belongs to no one department of medicine or surgery, but is common ground upon which the general practitioner of dentistry and medicine, physician and surgeon, eye, ear, nose and throat specialist, and lastly the internist and oral surgeon all meet with equal responsibility?

RADIOGRAPHIC FINDINGS IN THIRTY-FIVE EDENTULOUS JAWS

Number of tooth areas examined	560
Root fragments with normal appearing overlying tissues having definite periapical rarefied areas	5
Root fragments with normal appearing overlying tissues without periapical rarefied areas	3
Rarefied areas remaining unhealed after the removal of teeth	2
Foreign bodies without rarefied areas	0
Foreign bodies with rarefied areas	0
Imbedded teeth	2
Percentage of tooth sockets that did not heal normally where the entire tooth was removed	4-10

RADIOGRAPHIC FINDINGS IN JAWS CONTAINING SOME NORMAL TEETH

Number of tooth areas examined	1,024
Root fragments with normal appearing overlying tissues having definite periapical rarefied areas	47
Root fragments with normal appearing overlying tissues without periapical rarefied areas	20
Rarefied areas remaining unhealed after the removal of teeth	9
Foreign bodies without rarefied areas	9
Foreign bodies with rarefied areas	0
Imbedded teeth	71
Percentage of tooth sockets that did not heal normally where the entire tooth was removed	9-10

CLINICAL STUDIES OF PULP TREATMENTS, INCLUDING REPORT OF FIFTY-ONE CASES IN WHICH DEAD PULPS WERE REMOVED

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(Read before the Illinois State Dental Society, March 22-25, 1920)

THERE are two principal avenues by which knowledge of diseased conditions is advanced—laboratory investigations and clinical studies. In considering the pathology and treatment of the dental pulp, our most important laboratory investigation in recent years was that of Dr. Thos. L. Gilmer (1) on the bacteriology of chronic alveolar abscess. Valuable studies of the relation of mouth foci to metastatic infections and of the tissues immediately surrounding the mouth focus have been reported by many investigators. Additional studies are in progress. We particularly need to know more of the activities of residual filaments of pulp tissue in cases in which there has previously been formation of secondary dentin, and of the possible building of cementum in the apical region subsequent to pulp removal.

There has been little progress in scientific clinical studies. We have been surfeited with the opinions of numerous writers, but these opinions have very generally been presented without a background of case histories upon which they should have been based. I do not recall a single article on pulp and root-canal treatment in the past ten years which included definitely recorded case histories as a basis for the arguments presented or the opinions expressed. All that has been written during the past decade has served to establish in the minds of most practitioners a more or less definite notion that chronic abscesses may cause systemic disease and it is therefore important to conserve pulps and to improve our technic in root-canal operations. To what extent there has been improvement in practice is difficult to judge, since we have no basis from which to calculate.

There should be the closest possible co-ordination between clinical and laboratory studies in the development of principles of practice. Laboratory investigations must be checked with clinical knowledge, and clinical studies must be supported by laboratory findings. In the *American System of Dentistry,* published in 1886, Dr. G. V. Black (2) described and illustrated the more rapid progress of pus pockets in depth towards the apices of roots than laterally around roots, and referred to this clinical observation many times in subsequent writings, including his book on *Dental Pathology* (3) in 1915. Since then Dr. Frederick B. Noyes (4) has reported his laboratory studies of the lymphatics of the dental region, which explains and substantiates the clinical observation which has waited thirty odd years. This is a good example of the value of the combination of laboratory and clinical investigation in establishing a clear understanding of pathological changes.

That which is most needed now is a careful survey and check on clinical procedures. Arsenic has been used for nearly a century to destroy pulps and we have no definite proof today that it does or does not penetrate to the apical tissues and destroy them, thus preparing the field for the establishment of a chronic abscess. Phenol, preparations containing formalin and other tissue destroying drugs have been used for years and we do not know if their use results in the formation of chronic abscesses. We are not certain that the use of cocain by pressure anesthesia is harmless to the apical tissues, particularly if a vital pulp is infected when the cocain is applied. For scores of years, we have been removing dead pulps and placing root fillings, and recently the question has been raised as to whether all such teeth should be extracted. It is a decided reflection upon the dental profession that we have not at hand the clinical evidence in form to settle these and other equally important questions.

During recent years, the writer has studied various methods for the development of clinical studies of pulp cases and the principal object in writing this paper is to present a simple plan by which each dentist may do some important research on his own account and learn what he should do to improve his technic and thus give better service. In presenting this plan I wish to make a special appeal to the younger men to interest themselves, not only in this plan, but in the development of the thought that our progress as a profession depends in no small measure on the keeping of good case histories by many practitioners. If we had a sufficient number of these before us today, we would not have the two groups of extremists, one advocating the extraction of every pulpless tooth, the other refusing to extract teeth which are unquestionably abscessed.

In developing a plan of keeping histories of cases of pulp treatment, it has been kept in mind that it should be simple, requiring practically no time to record the necessary data, and so designed as to fit in with or be independent of whatever system of bookkeeping the individual may have adopted. The following was determined upon as necessary data: Patient's name; address; age; the tooth; the diagnosis when treatment is begun, viz., the condition of the pulp, root-canal and apical tissues; whether the pulp is normal, hyperemic, exposed by caries, dead with no abscess, or dead with an abscess, and whether or not there had been previous treatment.

It should be recorded if the tooth is normal in color or if it is discolored. The method of destroying and removing the pulp should be noted, as should each subsequent treatment, with the name of the medicament employed. The method of sealing treatments should be indicated, and the kind and quality of the root filling should be recorded. Finally there should be provision for a record of subsequent radiographic examination and a notation of the color of the tooth.

A form for all of this data is printed on an envelope (see Table 1) and is so arranged that after the first appointment, when the name, address, etc., are entered, it is only necessary to make an X or enter a date for each visit of the patient. This record is made on an envelope in order that radiograms may be enclosed, thus keeping them with the case history.

Different rules may be determined upon regarding radiograms. If pulps are vital when treatment is undertaken, it may not be considered necessary to take a radiogram in connection with the treatment of the case. None may be taken until a year or so afterward to record the final result. It is desirable, however, in the majority of cases to have a radiogram made with diagnostic wire in place, when the root-canal is ready for filling, a second radiogram immediately after the filling is placed, and a third a year or so later for the final record. If the pulp is dead, it should

be the invariable rule to have a radiogram before treatment is undertaken, and other radiograms in connection with the root filling as stated above.

If such a record is kept it will be possible to tabulate and study from time to time the results of various methods. Such a study of several hundred cases in which arsenic had been applied would settle the question as to whether or not there is danger to the periapical tissues. If there occurs permanent injury to the periapical tissues from the use of any drug sealed in canals, a series of case histories would furnish the evidence necessary to establish the fact. If one method of root-canal filling is better than another, it should be demonstrated by a tabulation of a few hundred cases. Is it not quite apparent that many of the questions which have been under almost continual discussion for the past decade or so, can within a few years be settled if a number of us will commit ourselves to the recording of histories of these cases?

I have kept a careful record of my cases since I have been in practice, but only in recent years has this very simple plan been developed of tabulating the accumulated records. During the past year, complete histories of all pulp treatment cases have been transferred from my books to these envelopes and we are now collecting the check-up radiograms. I had expected to have enough of these at this time to make a somewhat exhaustive report, but that must be delayed for a time. With the hope that I may interest a number in this plan, I show several tabulations, particularly to demonstrate its possibilities. It is not sufficient for one person to do such a piece of work. Similar studies should be made by many, in order that errors may be reduced to the minimum.

Table 2 is a record of all pulps removed since I began practice. Such a table presents interesting data. For example, the pulps removed are in three groups; 892 vital pulps by the use of cocain pressure anesthesia, 162 to which arsenic was applied, and 323 dead pulps, a total of 1377. This is an average of 69 per year. It shows a reduction of over 15% in the number of pulps destroyed in the past five years, as compared with the preceding five years. It shows that the use of arsenic has been almost abandoned in the past four years.

Additional data along several of the lines previously mentioned is being collected. For example, Table 3 is suggestive of what might be learned from a tabulation of cases in which arsenic had been employed. While only eleven cases are here reported—too few for definite deductions, they point toward the conclusion that arsenic does not injure the periapical tissue, as only two of the eleven developed abscesses; an upper cuspid the root-canal of which was not accessible to the end, and a lower second molar in which it was not possible to make a good filling in the mesial canals. In the case of this tooth, the abscess was at the apex of the mesial root only. It is doubtless of importance in such a study to have a record of the age of each patient, the drugs sealed in after the pulp was removed, the elapsed time until the root filling was placed, whether or not the pulp cavity was at any time left unsealed, and other data necessary to exclude or explain other causes of involvement of the periapical tissues.

Table 4 is a similar tabulation of cases in which pulps were removed with cocain pressure anesthesia. Only 101 cases are included, about one-ninth of the total number in my practice and too few to prove anything, altho several interesting possibilities are suggested. It should be stated in the first place that the percentage of abscessed teeth is much higher than it ought to be for the entire number of cases, for the reason that many of these cases were radiographed subsequent to the treatment because they gave trouble and on this account the percentage of cases in which abscesses occurred is higher than average. We

have not yet called in a sufficient number of patients for check-up radiograms to get a proper balance of our tabulation. The same explanation may be given for the high percentage of poor root-canal fillings. The fourteen abscessed teeth consisted of 1 central incisor, 3 lateral incisors, 1 cuspid, 1 first bicuspid, 2 second bicuspids, 1 first molar, 1 second molar and 2 third molars.

Another prominent feature of this tabulation is the average age of this group of patients when the root fillings were made, viz., 44 years. It will also be noted that in about half of them—48 of the 101—I had noted at the time the root fillings were made that the canals were inaccessible to their apices. This corresponds with the high average age. I am convinced that this tabulation does not represent average conditions, but points to the necessity of a much larger series of cases in order to draw reliable conclusions.

Table 5 is a tabulation of 51 cases in which dead pulps were removed. There are included two cases in which my father made the root fillings in 1888, thirty-two years ago. Altho this table includes a small number of cases—about one-sixth of my total for twenty-one years, it bears evidence of much importance in our study of these cases in relation to the problem of focal infections. It will be noted that of the 51 cases, 37 were not abscessed when treatment was undertaken; *the pulps were dead, but there had been no destruction of the periapical tissues.* An analysis of this group of 37 shows that in 35 the periapical tissues appeared to be in perfect condition when subsequent radiograms were taken. This is 94% of successful results, which is nearly as high a percentage as we should expect in cases in which vital pulps are removed. This series alone is, in my judgment, sufficient to demonstrate without question that the proposal to extract pulpless teeth is entirely unsound.

It may be that a larger tabulation will show some difference in the final results. It is realized that it will be necessary to run down the history of every tooth so far as is possible, recording those that have been extracted, and radiographing those which remain. An accurate report also requires that there be a definite record of the condition of the bone about the root apex when treatment is undertaken. The series of radiograms should be interpreted by several experts to insure the most reliable report. Other data, such as the drugs used in subsequent treatments, the root-canal fillings, etc. must be taken into consideration. Even tho figures so compiled shall give results somewhat at variance from this small group, I believe the fact is now established that it is wrong to extract a tooth because it has a dead pulp.

On account of our special interest in this subject I wish to throw upon the screen the radiograms of this group of fifty-one cases. These are not the ordinary lantern slides, but the actual radiographic films projected on the screen by an exceptionally powerful lantern arranged for the purpose. I will show the entire series—those with poor root fillings as well as those with good root fillings, those abscessed and those without abscesses. I would like to impress the fact that these are not a selected group of films, but include every radiograph that I have thus far collected in checking up cases that presented with dead pulps.[1]

In conclusion, let me express the opinion that much of the uncertainty that now exists relative to pulp and root-canal treatment can be removed if a reasonable number of dentists will undertake to make a serious clinical study of the problems involved. I might add that the dental profession must develop a conscience which will force it to think a little more of its duty to the public in the employment of the most tireless and painstaking technic, and to consider a

[1]The films were thrown on the screen, but were withheld from publication until the study of this group of cases should be more complete.

little less the commercial features of the transaction.

DENTAL PULP CASE HISTORY—DIRECTIONS

This record is printed on an envelope, the illustration being actual size. The history is to be made out as the case progresses. The radiograms of the case are to be kept in the envelope. If the pulp is dead, or if the root has been previously filled, the patient is required to have a radiogram made before treatment is begun.

1. Enter patient's name, age, and address.

2. Indicate tooth by number or letter.

3. Diagnosis. a. If pulp is vital and normal, and is to be removed, mark X in first column. b. If pulp is vital, and is inflamed on account of exposure by caries or otherwise, mark X in second column. c. If pulp is dead, mark X in third, fourth or fifth column, according to the condition shown by the radiogram. It will be considered a slight abscess if any injury to the bone is shown, and treatment is undertaken. It will be marked in column "Abs. Extract" if treatment is not considered advisable. d. If there is a previous root filling, mark X in the last column, also write below in the same column: "Bone O.K." or "Slight Absc." or "Abscess, Extract" according to the condition shown by the radiogram.

4. Color of tooth. Mark X in proper column.

TABLE 1

DENTAL PULP CASE HISTORY

Patient's Name _____ Age _____

Address _____

Tooth		Diagnosis					Color		Removal						Treatment			Sealing		Root Filling							Subsequent Radiograph				Color	
RIGHT	LEFT	Vital, Normal	Vital, Inflamed	Dead, no Abs	Slight, Abs.	Abs. Extract	Previous R. F.	Normal	Discolored	Arsenic	Cocain, Pres	Infiltration	Conductive	Date, Removal	Creosote	Eugenol	1-2-3	Gutta-Percha	Cement	Length, mm.	Gutta-Percha	C. P. and G. P.	Inacces. Apex	Good	Fair	Resection	Bone O. K.	Slight Abs.	Abs. Extract	Uncertain	Normal	Discolored

5. Removal of pulp. a. If arsenic is applied, enter DATE in figures, in proper column, as 5-2-16. b. If cocain pressure is used, or novocain anesthesia, infiltration or conductive, enter DATE in proper column. c. Enter DATE pulp is removed in proper column.

6. Treatment. Enter DATE of application of medicaments. If a second treatment of the same drug is made, enter DATE below second horizontal line, etc. Doubtless many dentists would prefer to have other drugs entered in these column headings, and the form should be printed accordingly.

7. Sealing. Mark X in proper column.

8. Root filling. a. Mark in first column length of tooth from occlusal surface or incisal edge in millimeters, making measurement with a fine smooth broach and a Boley gauge. Place diagnostic wire and have radiogram made. b. Mark DATE in second or third column to indicate gutta-percha alone, or chloro-percha and gutta-percha used as root filling. Other methods of root filling may be indicated in extra columns if desired. c. If canal is inaccessible to apex, indicate by fraction ½, ⅔, or ¾, etc., according to distance diagnostic wire shows in radiogram. d. Have radiogram made of root filling, mark X indicating whether it is considered a good or a fair filling. In case it is a poor filling, a new root filling should be made, also another radiogram. e. In cases of teeth having more than one canal, use a separate horizontal line for each canal, and indicate each by writing the initials, as m-l, m-b, d-b, dis, ling, buc, etc.

9. Resection. If root is resected, enter DATE in this column.

10. Subsequent radiogram. A check-up radiogram should be made of each case a year or more after the root filling. When this is done the DATE should be entered in the proper column, indicating the condition of the bone at that time. Additional radiograms should be made after several years.

11. Color. The color of the tooth will be marked by the DATE of a subsequent examination.

TABLE 2

PULPS REMOVED—1900-1919

Year	Pressure Anesthesia Cocain	Arsenic	Dead Pulps	Total
1900	3	19	5	27
1901	5	28	16	49
1902	73	14	18	105
1903	38	14	29	81
1904	66	4	27	97
1905	69	4	9	82
1906	63	2	16	81
1907	54	9	14	77
1908	30	7	12	49
1909	45	11	24	80
1910	35	2	12	49
1911	42	11	8	61
1912	61	7	14	82
1913	59	4	16	79
1914	44	9	14	67
1915	53	8	21	82
1916	37	1	19	57
1917	39	4	12	55
1918	34	1	20	55
1919	42	3	17	62
	892	162	323	1377

This is a tabulation of all pulps removed by the author during the twenty years he has been in practice. They are divided into three groups (1) those removed by cocain pressure anesthesia, (2) those removed after application of arsenic, (3) dead pulps removed. By five-year periods, the total number of vital pulps removed was as follows: 1900-04, 264; 1905-9, 294; 1910-14, 274; 1915-19, 222. This is a reduction of about 25% for 1915-19, as compared with 1905-9. (Only about half time was devoted to practice in 1900 and 1901, so that the figures for the period 1900-04 are not proper for comparison with later years.)

TABLE 3
PULPS DESTROYED WITH ARSENIC

Year Pulp Removed	Tooth	Age	Root Filling	Years Elapsed	Bone O. K.	Abscessed
1901	U 3 M	51	Inac.	18	x	
1903	L 3 M	20	Inac.	15	x	
1907	L 1 M	41	Good	10	x	
1907	U 1 B	41	Inac.	10	x	
1909	U Cuspid	59	Inac.	1		x
1909	U 2 M	59	Inac.	10	x	
1911	U 2 M	33	Good	8	x	
1912	L 2 M	32	M Poor D Good	7		x
1913	U 2 B	35	Good	4	x	
1914	L 2 M	47	Inac.	2	x	
1915	L 2 M	48	Good	3	x	

Average age of patients at time of root filling, 42 years.
Average years elapsed before taking radiograms, 8 years.

Table 3 includes too small a number of cases to justify practical deductions. It is presented to illustrate a plan of tabulation by which it might be determined whether or not arsenic is safe to use. In the column headed "Root Filling" the condition of each root filling as shown by radiogram, is indicated. "Inac." means that the root-canal was inaccessible to the apex, the root filling extending only part way, but there was no showing of a canal beyond the root filling. It will be noted that all except one of those marked inaccessible were for persons from 41 to 59 years of age, so that the diameter of the canals had very likely been reduced by the formation of secondary dentin. In the eighth case, a lower second molar, the filling in the distal canal was good, that in the mesial canals poor; the abscess was at the apex of the mesial root only, which would indicate that the imperfect technic and not the arsenic was the cause of the abscess. The upper cuspid which was abscessed 1 year after removal, was also inaccessible to the apex. After this tooth was extracted, it was split lengthwise, but no canal could be found in the apical third by macroscopic examination.

A tabulation of cases should also include a list of teeth which had been extracted. The effort should be made to have the complete history of every tooth.

Table 4 is a tabulation of results in 101 cases out of a total of 892 in which pulps were removed by cocain pressure anesthesia. The number reported here is too few to make practical deductions. Undoubtedly the percentage of abscessed teeth is too high—14%—for the reason that practically all of the films representing the cases which abscesses were already at hand when the collection of this data was recently begun. Doubtless many more films of teeth not abscessed will be obtained without a corresponding percentage of abscessed teeth. Neither are we justified in the deduction that 18% of all of the root fillings in the 892 cases were poor. It will be noted however that the abscessed teeth in the last column correspond very closely with the poor root fillings listed in the fifth column. Special attention is called to the average age of these patients—44 years—in relation to the large number of the teeth—48 out of 101—the canals of which are reported as inaccessible to the apex. This table is presented for the purpose of showing the possibilities of a more complete tabulation of such data.

Table 5 like the others includes too few cases to permit of accurate deductions; only 49 out of 323 cases in which dead pulps were removed by the writer; it also includes 2 cases (1888) of Dr. G. V. Black's. It is assumed

TABLE 4

REPORT ON TEETH FROM WHICH VITAL PULPS WERE REMOVED WITH COCAIN PRESSURE ANESTHESIA

Year Pulp Removed	Number of Teeth	Root Filling			Subsequent Condition of Bone	
		Good	Inac.	Poor	O. K.	Abscess
1901	2		2			2
1902	2		2		2	
1903	4	1	2	1	3	1
1904	3		3		3	
1905	7	2	4	1	6	1
1906	1	1			1	
1907	7	2	2	3	4	3
1908	6	1	4	1	6	
1909	1			1	1	
1910	5	2	2	1	5	
1911	11	4	6	1	10	1
1912	3	1	1	1	3	
1913	11	5	4	2	9	2
1914	8	5	2	1	7	1
1915	18	6	7	5	15	3
1916	1		1		1	
1917	7	4	3		7	
1918	3	1	2		3	
1919	1		1		1	
	101	35	48	18	87	14

Average age of patients at time root fillings were made, 44 years.
Average years elapsed before taking radiographs, 6 years.

TABLE 5

REPORT ON TEETH FROM WHICH DEAD PULPS WERE REMOVED

Year Pulp Removed	Number of Teeth	Condition of Bone when pulp removed			Root Filling			Subsequent Condition of Bone	
		O.K.	Abse.	?	Good	Poor	?	O. K.	Abscess
1888	2	2			2			2	
1903	2	2			2			2	
1904	4	3	1 Acute		4			4	
1905	3	3			3			3	
1907	2	2			2			2	
1908	2	2			2			2	
1909	4	1		3	2		2	1	3
1910	2	2			2			2	
1912	3	3			3			3	
1913	6	4		2	2	2	2	4	2
1914	4	2	1	1	1	1	2	1	3
1915	4	3		1	4			2	2
1916	4	2	1	1	2	2		2	2
1917	3	3			3			3	
1918	5	2	2	1	3	1	1	2	3
1919	1	1			1			1	
	51	37	5	9	38	6	7	36	15

Average age of patients at time of root filling, 39 years.
Average years elapsed before radiograms, 7 years.
Final result in cases in which no abscess when pulp removed, 94%.

that those cases which presented before the advent of radiography were not then abscessed, if the radiograms taken recently show the bone to be O. K. about their apices. In recent years, radiograms have been taken of every dead pulp case before treatment was undertaken. Of the 51 cases, 37 were not abscessed when the dead pulps were removed. Of this group of 37, only 2 were abscessed when the subsequent radiograms were taken; this gives apparently successful results in 94% of these cases. While a larger series of cases may show considerable difference in this percentage, there would seem to be little question of the error of

some dentists who are demanding the extraction of all teeth presenting with dead pulps. In studying dead pulp cases, a sharp line must be drawn between two groups, (1) those in which there is no apparent involvement of the periapical tissues, and (2) those which are abscessed. Cases of group one should show nearly 100% success, cases of group two should show nearly 100% failures.

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Discussion

H. A. Potts, Chicago: In the study of such an important subject as the one before us, we must be very careful in our observations and not be too dogmatic in our discussions lest we, in our enthusiasm either become too radical in our treatment, or by our adherence to habits, make an even more serious mistake in denying the patient the relief he should receive at our hands.

At the present time we are in the midst of an epoch-making period in dentistry, and we should make our conclusions only upon well-founded principles of physiology, pathology and bacteriology.

Health is only a relative term and one's state of health is not infrequently judged by the opinion of the patient himself; he in many instances has so gradually digressed from normal that he has forgotten what it is to feel well. As I see it, at the present time the greatest good so far demonstrable will fall upon the coming generation, in that by the constant care of the children's teeth there will be a marked reduction in the communicable diseases, as has been demonstrated by the report of the Bridgeport (Connecticut) Health Department, and that by the care of beginning caries thru the education of the public, a vastly greater number of pulps will retain their vitality, thereby, avoiding much of the controversy over the removal of the pulpless teeth.

Just now, however, pulpless teeth are with us, and we must work out the treatment of them primarily with the health of the patient in view, the retention of a masticatory organ being secondary, for who would suffer a miserable existence or even death rather than lose a molar. Both of the above conditions have beyond a doubt resulted from the retention within the mouth of pulpless teeth, and as each individual patient presents a problem within himself, all the knowledge of medicine and dentistry pertaining to it should be brought to bear in order to determine just how conservative or just how radical the procedure should be, and that the patient may be cured or preventd from having a recurrence, or that he avoid more serious lesions later on

I am of quite the same opinion as the essayist regarding the filling of root-canals When there has been a definite destruction of the peridental membrane about the apex of a tooth, I am very skeptical of our ability to sterilize the space and denuded cementum. Even if that were possible, the conditions for reinfection are so favorable that it occurs it seems, sooner or later, in the majority of cases.

Neither should we place too much dependence upon the skiagraph, as it is not a photograph revealing all conditions present, but merely the measure of permeability to the rays in practically one diameter, the film being only in profile.

The skiagraph does not show infection, but as infection is the most frequent cause of absorption of bone about the apices we are usually justified in calling it such when we have to deal with pulpless teeth.

A diagnosis should never be made upon radiographic evidence alone.

As the infections which produce absorption occurring at the apices of teeth are usually chronic, the space must necessarily have been infected long before the skiagraph will reveal any bony changes. We must take into consideration the history and clinical findings.

The "rheumatic" teeth which cause a little discomfort at times, are usually a little tender to continued pressure over their apices; pressure upon the tooth in different directions will often cause a little pain also. The mucous membrane over their apices is frequently reddened and often cyanotic. One should exclude in these cases an inflamed peridental

membrane due to other causes, as overhanging margins of fillings and crowns, foreign bodies, and calculus.

The question to be decided is, will the physical condition of the patient warrant the retention of the tooth even for a period of time or should it be removed?

In my practice I am governed by the necessity of removing every possible source of infection, that necessity being based upon the judgment of competent physicians and specialists in their respective lines, not their opinion as to whether or not certain teeth should be extracted, but their judgment as to whether the existing physical condition of the patient will warrant the retention within the body of any possible source of infection; then, as a last resort, after the presence of all other foci has been excluded, I do not hesitate to extract.

While not having abandoned root amputations, I have done very few within the last year, operating upon only urgent and selected cases, the reason being that later cultures in six cases showed pure cultures of streptococci, even tho the surgical results were all that could be desired.

Regarding root-canal fillings, it seems that the most favorable results must be expected in cases having live sterile pulps which under strict asepsis can be devitalized and the root filled at one sitting without the use of root-canal medicaments.

As to the curettage of sockets, in general surgery the practice of curetting abscesses and granulating sinuses has been discontinued because of the danger of opening up lymphatics and blood vessels, but in the socket and bony cavity beyond the apex it seems that conditions are different.

Drainage of an infected area is always indicated when possible. Here we have a deep narrow outlet which will soon become covered with over-hanging gum tissue, and which will retain a plug of clotted blood.

It seems in the majority of cases, when the infected granuloma has not been removed, that it does become resorbed and is replaced by new bone. It also seems that the logical thing to do is to curette it away and allow the cavity to fill with fresh blood, which will become organized, rather than put the extra burden upon the vital forces.

When the absorption has extended beneath the bony septa and the cavities which have formed at the apices of multi-rooted teeth have become connected, it is my practice to remove the septum to facilitate the curettage. I have not found it necessary to make another incision in the gum or mucous membrane as the socket unusually affords ample access.

Edgar D. Coolidge, Chicago: We have heard two very valuable papers this afternoon.

Dr. Black in his usual, careful and thoro way has shown us a thing which very few men in the country could do. While we might be able to go thru our records and say we have removed so many pulps, I doubt if there are many dentists who can say what they have used in every treatment of each tooth between pulp removal and the filling of the root-canal. He has today presented to us something not based on his opinion from memory or from looking at a few radiograms, but from the actual history of each case. That is the only way we will ever come to an intelligent solution of this problem of whether or not we should remove pulps and attempt to fill root-canals.

A few years ago we were startled by learning what we did about infections around the teeth and everybody got busy to extract teeth, and that wave has grown in volume until it has swept the country and carried us far beyond what was intended by the originators of this idea. Now we frequently hear of men advocating the extraction of every tooth requiring treatment. From these papers this afternoon one can see the trend of thought of these two distinguished men. It shows that they are conservative, and that *it is not* time for us to lay aside our root-canal instruments.

Dr. Black stated in his paper that abscesses may cause systemic disease. This statement is recognized as a fact, but it is extremely difficult to determine what teeth are guilty. It is only by such work as Dr. Black has presented to us here that we will ever arrive at a reasonable conclusion. We do not know today whether the abscesses we find are made by mechanical injury from our instrumentation, or whether the absorption has come about from chemical action of the drug we put in the tooth, or whether it has been caused by infection. We have not sufficient data to determine these things It is certain that all of these conditions are not caused by infection. The only way we may determine this is by keeping complete records of what we use in the treatment of these teeth, following them year after year by radiograms and observing the results of our work. Everybody will be surprised to find what his records reveal. I find my records are slightly different

from those of Dr. Black. I find that I removed twenty-four pulps with cocain in 1918, and twenty-two in 1919. I have not used arsenic except in connection with a local anesthetic in three cases, using arsenic over night followed by cocain pressure the next day when possible to get an exposure of the pulp. I feel it is safer not to use arsenic. I treated 15 dead pulps and pulpless teeth in 1918 without abscesses, and 28 in 1919. This tabulation is very carefully made. There is nothing of very great importance in my tabulation at this time, but it is of interest, and I think you will all find as you keep a detailed record of each treatment that many things will be brought to your attention that you have not noticed in the past and you can get a much better perspective of these operations than by relying upon your memory.

The fact that Dr. Black has shown the difference in value between a good root-canal filling and a poor canal filling in his tabulation is one of the most important things. Of that list of good fillings he showed on the screen only 9 per cent had abscess after seven or eight years, and in the list of poor fillings there was about 63 per cent of abscesses. It seems to me, that such tabulations are of great value as they represent the work of a great many operators in widely separated parts of the country and these fillings were put in long before the most rigid aseptic precautions were taken. It seems to me it is not presuming too much to say that at the present time we can successfully remove a pulp and fill the root-canal and have it remain so that it will not be a menace to the patient's health. I believe, of course, we must use a great deal of judgment in determining just what teeth are safe to retain.

The other thought that I wish to bring out is simply this, that root-canal work necessarily is a long and more or less tedious process, and it is necessary to work out a method of practice that is systematic and efficient that does not involve too much difficulty and time, and follow such a routine that when we have completed a case we will have a successful piece of work that is done without causing the operator to dislike this part of the practice of dentistry.

M. L. Hanaford, Rockford, Illinois: In the essay of Dr. Black we have had another evidence of the wonderful genius of the author for getting at foundation facts and putting them in order so that they may be of undoubted value. The expressed belief that we have had enough of opinions, and the implied inference that dentists and dentistry have been made the goats for the last decade are certainly timely and will appeal to everyone who has encountered the smug complacency of some of our confreres, and the gloomy apprehension of certain of the laity. The profession will certainly welcome the effort shown in the paper to do something about it rather than to plant a darker picture of our sins and shortcomings.

We may fairly be said now to know that infection from blind abscesses may cause various diseases of remote parts. That being the case what are we to do about it? Extract all pulpless teeth say some (I heard about a man who cut off a toe and cured a corn!). Extract the hopeless ones, treat and cure and fill the roots of the favorable ones, check up your work by frequent examinations and radiograms, say others—the author of the paper among them. How to distinguish the favorable ones? How to manage treatment? What drugs are helpful? What are harmful? How to fill roots thoroly and safely? These are the things we want to know, and obviously these are the principles which the proposed plan of recording data will fianlly establish.

It is a hard thing to induce some men (I am afraid a good many men) to take up a line of work merely to find out a few facts, too many of us are asking what is there in it for me? There are too few men like the author of this paper and the man whose monument in bronze stands out yonder in Lincoln Park, who seek truth for its own sake, but yet there are a few, and we who are appealed to, can do no less than to help by doing some of the drudgery, in studying and tabulating our cases, without a thought or hope of commercial reward.

A suggestion or two as to what the rank and file of dentists, have a right to hope for. We have some wonderfully skillful technicians in our profession a few here and there. They cannot do a fraction of the work necessary to be done. We, the rank and file, really have the most of it to do and we are not able either by education or technical ability to follow the difficult, time-consuming routine of these few experts. They may spend days where we may spend hours in completing an operation. Therefore, I submit that we are not asking too much when I say that we should have greater simplicity of technic, that the sterilization and filling of a tooth root should be brought within the ability of the

average dentist; in other words, it should be "fool proof." The alternative is obvious. In that line probably the use of late, of thin solutions, as the chloroform-rosin of Callahan and the silver nitrate solution, depending upon capillary attraction to assist largely in their introduction, are cases in point.

I am sure all who have tried it have encountered the extreme difficulty of carrying the liquid accurately to the orifice of the canal in upper teeth, and leaving it there. As a means for doing this a certain broach will be found admirable.

This broach, devised by Dr. Duncan of Rockford, has a loop or minute reservoir placed at a little distance from the point. A drop of desired liquid is picked up from a clean slab, and the point of the broach inserted in the orifice of the canal and gently carried upward. The moment the drop of liquid touches the tooth, capillary attraction carries it into the root, following the broach and to the extremity of the canal with all its ramifications.

J. G. Reid, Chicago: Dr. Logan in his paper referred to the amputation of roots of teeth. Something like twelve or thirteen years ago I read a paper before the Odontological Society of this city in which I discussed this subject, and strongly condemned the practice. Following that, something like five or six years ago, in discussion before the Illinois State Dental Society I made a statement that 100 per cent of the amputations of the roots of teeth which I had performed or had conducted in my practice proved to be failures, and I believe those operations were as intelligently and skillfully done as they could have been by anybody. I am very glad to hear so eminent a surgeon as Dr. Logan make the statement that in very few cases would that operation be successful. After a while they are going to be failures. It is only a question of time.

The next point is with reference to pulpless teeth, and the point we are arriving at today is that we are positively discrediting the opinion or judgment that all pulpless teeth should be extracted.

E. K. Blair, Waverly: If you step into the office of a grain elevator anywhere thruout the state you will find a system of bookkeeping that will surprise you. It has been so well worked out that the men handling grain can make their own records of every business transaction.

If you go to a Sunday school you will see complete forms of books and records furnished every superintendent. If you enter any walk of life you will discover printed matter for doing business in almost every line, and it seems to me, we, as a profession, should develop more system in keeping our records.

I would like very much for a traveling man that comes into my office to say to me, "Here are these envelopes planned by Dr. Black, ready for use at so much a thousand. How many will you have?" The dental profession ought to provide these things, and when we have at hand that sort of material, we will be able to collect the data that we need to produce results we are seeking here today, and that we so much need everywhere.

I wish something might be done to make it possible to have the Black envelope right away. I have kept records of my cases for many years, particularly of root-canal treatments, and I have a system of my own to which I can turn back readily and see what I have done. But now the X-ray is coming into daily use in the office, this envelope and this system of Dr. Black's appeals to me very much.

Thomas L. Gilmer, Chicago: Dr. Black's conclusions based on his students are very encouraging. The systematic way in which he has gone about the work is the only way to get real results, results to which all must pay attention.

I was pleased that Dr. Logan sounded a note of warning against extended surgical operations for the cure of chronic alveolar abscesses. I, too, have been examining for several months large numbers of radiograms made from edentulous jaws, and other jaws where only a few of the teeth had been removed in which no curettement had been done. So far I have found one case out of several hundred where there was any sign of any infection left in the jaw.

Some ten or twelve years ago at one of our annual meetings I was asked to what extent I did curettement after the extraction of teeth. I replied, "only to those cases where large areas are involved did I think curettement really necessary." Today if I am satisfied that there is a granuloma of considerable size in the socket apex, which has not come away with the root, I believe it good practice to remove it, since we still get a cure sooner than if it is left in, but nature will remove most of them. This is easily proven by taking radiograms of areas formerly having ab-

scessed cavities. Extensive surgical operations are not necessary for the removal of abscessed teeth therefore should be condemned. Cysts in the jaws connected with abscessed teeth require more extensive surgical procedures, since all epithelial tissues must be removed for reasons well understood.

As to the resection of the roots of teeth. Dr. Reid has made the statement that 100 per cent of resected roots of teeth are failures. In this statement he makes a mistake. Some of them are failures, but they are not all failures by any means. I have many radiograms of abscessed teeth which demonstrate a cure, as a result of root resection, that I shall be pleased to show my friend, Dr. Reid. To leave the ends of a root of a tooth in the jaw which has been divested of its peridental membrane is wrong, since it is dead bone, but unlike other dead bone cannot be sequestrated. Nature seems to tolerate dead dentin in a far greater degree than it does dead cementum. I have in my possession, pictures taken at various times over a period of several years, showing the progress of the filling in of large bone cavities, following resection of a root. In the last picture there is no rarefaction whatever, therefore, I believe that the infection has been cured by the resection and curettement.

I am as strongly of the opinion as ever that infected teeth are bad for people, but before wholesale extraction of teeth, we should take into consideration the physical condition of the individual at the time. If he is a very sick man and no other foci of infection about the body have been found, or if found and eliminated, then I should say, get rid of all such infected teeth as well. I would not think of resorting to the resection of roots for the cure of abscesses, or attempt a cure of them by treating, for such a patient. Teeth are too valuable to extract ruthlessly, but life and health are too precious to jeopardize by retaining teeth which are frankly injurious. If one's physical condition is up to par, then I might retain doubtful teeth; if they are valuable organs, I would only resect roots which are easily accessible and for these whose physical condition is good. All such teeth should be kept under observation at regular intervals. I do not believe a tooth is dead because its pulp is dead. If the peridental membrane is alive it is not a dead tooth.

Dr. Logan (closing on his part): In the first place, I wish to say a few words with reference to Dr. Black's paper. He has given you some valuable information today and you should assist him in securing additional proof. He has told you that a pulpless tooth need not be extracted simply because it is pulpless. He has presented convincing evidence that there is an opportunity to treat a pulpless tooth and fill it successfully, providing the pericemental membrane about the apex has not been destroyed. He has not conveyed to you the idea that you can save all teeth. His central idea is based on one thing. If the pericementum is alive at the end of the root, you have a chance to save the tooth. You should assist him in securing these necessary records to carry the message to Garcia, the message to the medical and dental professions and thru them to the public.

Relative to my own paper, permit me to summarize as follows:

1st. In my opinion sufficient evidence has not been secured by either the dental or medical profession to warrant a discontinuance of filling all root-canals in teeth having normal supporting tissues if the size of these canals favors placing a filling to the apex.

2nd. One is not warranted in advising a patient to have the root-canals filled in a tooth about which exists a chronic periapical infection that has resulted in the destruction of the pericemental fibres. The only exception I would make to the last statement is when a patient has never suffered from a disease that might be influenced by chronic infection. and the tooth is one that experience has taught is a favorable risk for root amputation.

3rd. If a patient is suffering from some disease held to be caused or influenced by chronic localized infections, I would advise extraction of all pulpless teeth held to be involved with chronic periapical infection.

4th. Until additional evidence is presented I would not feel warranted in demanding curettement in all cases following the extraction of teeth about which there is a chronic periapical infection, but I do believe curettement is demanded in many cases.

5th. Would advise the removal of all root fragments when found, but have not made it a rule to demand the removal of all imbedded teeth in the mouth of the healthy when the findings are negative—except in those cases where the tooth had fully developed and normal bone was not found by the aid of a radiogram to be in contact with the enamel of the crown. The absence of bone in contact with the developing tooth should not be confused with the foregoing statement.

6th. In conclusion, permit me to urge the necessity of radiographing edentulous jaws and all tooth areas for root fragments, imbedded teeth and unhealed rarefied areas—for the reason that each occurs with sufficient frequency to demand our acceptance of this procedure as routine.

Dr. Black (closing): We must draw the line very sharply between the two groups of cases: If a tooth has a dead pulp, and there has been no destruction of the peridental membrane, there is absolutely no reason why we should not get exactly as good results in the treatment of that case as in a case where we remove a vital pulp. On the other hand, if the periapical tissues have become involved and if the peridental membrane has been detached from the end of the root, it is an entirely different proposition, because we have to consider the dead cementum. Cementum is dead if there is a detachment of the peridental membrane from it. Let us keep these two things clear in our minds because the two groups of cases generally require widely different treatment.

I purposely did not go into the question of focal infection because I wanted to hold my paper within very close limits. I take it for granted that the majority of men in the profession today recognize the systemic danger of an infected area anywhere in the body, and that it is our duty as members of the dental profession to see to it that the mouths of our patients are free from areas of infection. That is our duty in preventive medicine.

I was pleased to hear the conservative views of Dr. Logan and of those who discussed his paper relative to the treatment which should be employed in eliminating these bone infections. A large percentage of these cases get well with no other treatment than the removal of the teeth. Some dentists are advocating the removal of a considerable portion of the neighboring bone in connection with the removal of abscessed teeth or teeth having pyorrhea pockets, in order to be certain that infection is eliminated. These same men are telling us to extract every pulpless tooth. We must study these conditions carefully and take a more sane view of the situation.

The pulp treatment problem is one of the most complex with which we are confronted. There are so many things that enter into each individual case; it is not a question that can be settled by following along a single line. If in a group of cases, one should use a certain drug, and that was the only item specifically recorded, a study of the after results would not mean very much, because the medicament used is only one of the things that must be considered. There is the question of the condition when the case presents; the question of whether the root-canal has been left open or if it was always sealed; the question of the root filling material and the perfection of the root filling technic; the question of the age of the patient, and often other factors must be taken into consideration.

I have presented a scheme which does not require much time or trouble. The records of most dentists have not been kept in sufficient detail so that they are available for after checking. If we go on forever on the plan we have been following, we never will be able to make a tabulation of results which will give us a proper basis for modifying our treatment. I want to appeal to the younger members of the dental profession to adopt this scheme because it is a simple thing for them to keep their records so that in five or ten years from now they will be able to tell us what measure of success they have been having. In dealing with these cases of pulp treatment, if we can get a large number of records together, we can know what is the best thing for all of us to do.

A BIOCHEMICAL STUDY OF BACTERIAL METABOLISM IN ITS RELATION TO CHANGES IN THE DENSER TOOTH STRUCTURES IN THE MOUTH

(PART II, EXPERIMENTAL)

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RESULTS are reported in this paper of a series of experiments related to an investigation of the underlying factors in destructive changes in the solid (calcareus) tooth structures in the mouth. In an earlier report it has been pointed out that the dissolution of the constituents of the teeth may, in part, be accomplished thru alteration in the acid-base balance and this would be the case whether referring to the dentin, cementum or enamel. It is apparent that the alteration of the oral aspect is not related to the activity of living cells, such as has in some cases been assumed, e.g. the absorption of bone by osteoclasts, but it is recognized that bacterial metabolism in the mouth may affect the hydrogen ion concentration, an increase in which would tend to bring about solution of the enamel. The action of no specific acid is indicated but, if the dissolution of the enamel (as in caries) is typical of acid action, in which histopathologists appear to concur, the hydrogen ion concentration would bear some relation to the process. This question has been investigated. It has not been practicable to ascertain the true acidity of the various types of mouth fluids, altho this is a field which would result in considerable profit if investigated under the proper conditions. The hydrogen ion concentration of the buccal fluid in health has been observed by Clark and Lubs, Michaelis and Pechstein, and probably others, but, without additional observations regarding related factors which affect the fluid, this information is not satisfactory in the study of lesions of the teeth. Our approach has been to observe the changes in dentin and enamel in known solutions of different hydrogen ion concentration and in artificial bacterial cultures. The experimental results indicate that the tooth material is affected by certain hydrogen ion concentrations but, it is important to note, not in a region where litmus or phenolphthalein would be of much value. Ground or broken teeth crowns appear to act as a buffer and the rise of hydrogen ion concentration in bacterial cultures is slightly altered by its presence. No noticeable rise in amino acid nitrogen has been observed in bacterial cultures to which had been added ground tooth material, as compared with control cultures. This may not, however, indicate that the dentin matrix is not digested thru bacterial proteolysis, since the organisms were studied in pure cultures, a relatively short period of time only was consumed during each experiment—not over three weeks—and, since bacteria utilize amino acids, their rise might not be detected by the methods applied. A series of cultures of some micro-organisms found in the mouth

indicates wide gaps between the hydrogen ion concentrations of pure strain. Another observation is that the region where B. bifidus and B. acidophilus grow actively is that where tricalcium phosphate remains in solution, and is dissolved rapidly from tooth sections.

The report is in three divisions; viz: (1) changes in the hydrogen ion concentration in artificial media effected by some characteristic oral bacteria—in the presence and absence of tooth substance; (2) effect of changes of the above order upon the constituents of the teeth; (3) proteolytic activities of oral micro-organisms and the constituents of the teeth.

I. pH Changes in Artificial Media

Four organisms were selected for study in artificial media. They were observed to effect changes in the hydrogen ion concentration such that they could be divided into two main groups. B. subtilis, and streptococcus viridans tended to establish a pH of between 7.8-8.4; while B. acidophilus and B. bifidus produced more acid media, pH 4.3-4.5. It was observed that all of these organisms could be grown in media of pH-6.5-7.5, but thru metabolism the acidity moved in the two directions as indicated. The aciduric forms could be grown in media as acid as pH 4.5, but not more acid. After preliminary work had been carried on to determine the optimal conditions, the method adopted was similar to the following: A pure culture of the organisms was planted in 250 cc of broth and incubated 24 to 48 hours at 37°C. They were then transferred, 1/10 cc to 50 cc of the media under investigation in 100 or 200 cc Florence and Erlenmeyer flasks. Each flask was cotton plugged and protected from evaporation with paraffined paper. One flask was set aside and each 24 hours another was removed for the analysis. The hydrogen ion concentration was determined, colorimetrically, by the method of Clark and Lubs *(Jour. Bacteriology,* II, 1, 2, 3). Duplicate series were arranged, in one of which five grams of finely ground dentin and enamel were placed. The teeth which were used were not carious but were either deciduous or pyorrhetic with intact crowns. They were freed from debris, blood and tissue immediately after extraction and dropped into lysol (2%) shaken frequently and, after 24 hours, were transferred to distilled water in which they were scrubbed and rinsed twenty times, the last few times shaken for some minutes. The crowns were cut off, split in parts, and further broken and ground in an iron mortar. Thin layers, five grams each, were placed between watch glasses and exposed in the Arnold sterilizer three hours each on three successive days. A few samples removed after the second heating exhibited growths but no growths appeared after the third heating. The material was then transferred to the flasks. Controls of the tooth substances in the same media were prepared, put in large test tubes (1X6 inches), plugged and protected like the flasks.

Three media were used; beef extract (1%) peptone (1%) broth for B. subtilis; dextrose, lactose and mannite (each 1%) with peptone (2%), salt (0.5%) and horse serum (10%) for streptococcus viridans and dextrose (1%), acetic acid (1%) broth for B. bifidus and B. acidophilus. The best growths and constant form were maintained in these media. Dextrose (1%)—ascites (5%) broth was found to provide variable results with some of the forms. Cooked meat, medium, (W. L. Holman. *Jour. Bacteriology,* Vol. IV, 1919) was used a number of times for the reisolation of the aciduric forms from some unknown mixtures.

The addition of tooth substance to otherwise similar cultures uniformly prevented marked changes at first in the hydrogen ion concentration, as is indicated by the following tables:

TABLE I

B. Subtilis in Beef Extract
Organism Isolated from Beef Extract

	0 Hrs.	24 Hrs.	72 Hrs.	7 Days
Control (Media)	6.8	6.8	6.8	6.6
B. Subtilis	6.8	6.6	7.0	8.2
B. Subtilis with Tooth	6.7	6.8	6.9	8.0
Media with Tooth	6.7	6.8	6.8	6.7

TABLE II

Streptococcus Viridans ("K") and Streptococcus Hemolyticus ("611")
Organism Isolated from Infected Root
Dextrose—Horse Serum

	0 Hrs.	24 Hrs.	72 Hrs.	7 Days
Control	7.2	7.2	8.2	7.2
K	7.0	7.8	8.0	8.2
K with Tooth	7.0	7.4	7.6	8.0
611	7.2	7.4	7.6	7.8
611 with Tooth	7.2	7.4	7.4	7.6

TABLE III

B. Bifidus ("689")—B. Acidophilus ("490")
Museum Natural History, New York
Dextrose Acetic Acid Broth

	0 Hrs.	24 Hrs.	72 Hrs.	7 Days
Control	6.3	6.4	6.4	6.3
689	6.3	5.4	4.3	4.2
689 & Tooth	6.3	6.4	6.0	5.8
490	6.3	5.8	4.5	4.6
490 & Tooth	6.3	6.2	6.0	5.4

TABLE IV

B. SUBTILIS
Maximum and Minimum Tests in Beef Extract

Media at	0 Hrs.	24 Hrs.	72 Hrs.	144 Hrs.	240 Hrs.
pH 1.8	1.8	1.7	1.7	1.7	1.6
2.8	2.8	2.8	2.8	2.8	3.2
3.8	3.8	3.8	3.8	3.8	4.2
4.8	4.8	5.2	5.6	6.0	8.0
5.8	5.8	5.6	5.6	6.2	7.8
6.8	6.8	6.2	6.2	7.6	8.4
7.8	7.8	7.6	7.8	7.8	8.0
8.8	8.8	9.0	8.8	8.4	8.4
9.8	9.8	9.6	9.6	9.6	9.4

TABLE VI

B. SUBTILIS
Beef Extract Bouillon

Hours	Control	A	B
0	6.8	6.8	6.8
24	6.8	6.6	6.4
72	6.8	7.0	6.8
96	6.8	7.4	7.2
120	6.8	7.8	7.6
144	6.8	8.0	8.0
168	6.6	8.2	8.4
192	6.6	8.2	8.2
240	6.6	8.2	8.4

TABLE VII

pH in Presence of Tooth Material

(a) Ground Enamel, Some Dentin.
(b) Ground Dentin, Freed from Enamel in Grinding.
(c) Whole Tooth.
(d) Whole Dentin, Freed from Enamel.

Not noticeable difference between a and b.
Not noticeable difference between c and d.

Control (Media)	0 Hrs.	24 Hrs.	72 Hrs.	144 Hrs.	240 Hrs.
B. Subtilis	6.8	7.2	7.4	7.8	8.2
B. Bifidus	6.8	5.4	4.5	4.2	4.3
B. Acidophilus	6.8	5.6	5.2	4.6	4.5

Culture & Tooth (a)	0 Hrs.	24 Hrs.	72 Hrs.	144 Hrs.	240 Hrs.
B. Subtilis	6.6	7.2	7.6	7.8	8.0
B. Bifidus	6.6	5.8	5.4	5.2	4.8
B. Acidophilus	6.7	5.4	5.2	5.0	4.6
Culture & Tooth (c)					
B. Subtilis	6.6	7.2	7.4	7.8	7.8
B. Bifidus	6.5	5.8	5.6	5.6	5.2
B. Acidophilus	6.6	5.6	5.4	5.0	4.8

Cultures incubated as long as three weeks showed slight change in hydrogen ion concentration after the seventh day. On a number of occasions cultures of B. bifidus, after the second week, were alkaline (pH-8.2-8.6). The smears indicated gram positive, long rod forms, and transplants grew again in fresh media. It is not known at the present time whether, if the sugar supply had been increased, the acid media would have remained. It is possible that a very prolific culture would exhaust the glucose and then metabolic changes, leading to organic alkalis, would proceed.

It appears from the experiments, as the reported observations indicate, that a local hydrogen ion concentration in the proximity of bacterial colonies might be acid, or alkaline, or neutral, depending upon acid forming substances, buffers, organisms, and intermediate substances necessary for growth. It is doubtful if the significance of this has been appreciated in the past. In the mouth, as in other regions, the acidity is too often determined by a faulty method, removing, under questionable procedure, mixed oral fluid and then titrating, or otherwise estimating the acidity or alkalinity. A neutral reaction may be recorded when some regions of the mouth may have been acid, others alkaline. The point is obviously important and needs careful study. One observation is reported here of the pH of artificial cultures of B. bifidus taken at three levels. Some tall columns of cooked meat medium were removed (slipped out) without agitation and divided into top, middle and bottom thirds. Each portion was shaken with an equal volume of distilled water, centrifuged and the liquor decanted. Indicator was added to the liquid and then uniformly distributed by shaking. A marked difference was observed between the liquid which had been removed from the top and bottom layers. B. bifidus, 1/10 cc of stock culture, planted and stirred into the medium with the pipette was incubated 6 days, but not agitated afterward. At the end of this time the bottom layer (corrected for dilution) was found to have a pH 4.7, the middle layer 4.9, the top layer 6.5. Presumably in liquids, due to diffusion, there would be a lesser difference. It would seem as tho we would need to discriminate in some cases between the local and general hydrogen ion concentration.

To sum up briefly, our experiments indicate that, with respect to hydrogen ions, B. bifidus and B. acidophilus grow in a region (pH-4.5) nearly seven thousand times more acid than the optimal region for B. substilis (pH-8.5) and streptococcus viridans (8.2); five hundred times more acid than is the blood, milk and mixed saliva (pH-6.9-7.1); but one-two hundredths as acid as the gastric juice (pH-2).

II. Changes of pH and Tooth Substance

Estimates of the relationship between the acidity of the saliva and the alteration of the dense calcareous tooth structure have in the past been hazarded. There has come to the writer's attention no report of experimental observations in this direction. Yet it must be clear that all statements regarding the solubility of the enamel, for example, in "acid" saliva, are valueless until we know at what acid or alkaline strengths the constituents of the teeth may be dissolved (cf. Clark and Lubs, *Jour. Bacteriology,* II, 3 [1917], bottom p. 219). Since the impor-

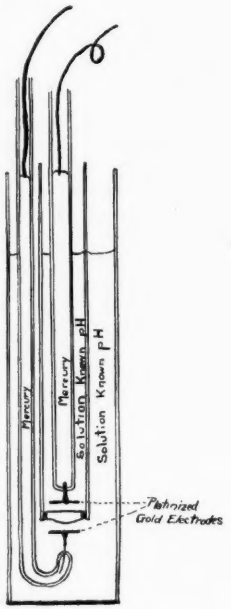
tance of results obtained in the series of experiments just reported rests in the relationship between the hydrogen ion concentration and the stability of the tooth substance, some experimental observations will be significant. The attempt has been made to estimate the change, or changes, in sections of enamel of teeth and in ground enamel at different hydrogen ion concentrations. Some of the results are extremely unsatisfactory and indicate that better methods must be devised or certain improvements made in this type of work. The tables are arranged from experiments near the end of the investigation after a number of attempts had yielded extremely variable results, due to no cause yet determined, altho under supposedly similar conditions.

(a) Electrical resistance of tooth sections.

Extracted first molars with solid intact buccal and lingual walls were selected with reference only to the age of the patient. The teeth were placed in physiological salt solution upon extraction. The crowns were then cut off at the gingival margin and were split on a line parallel to the buccal or lingual sides—i.e. mesio-distally. Each half was mounted on a block so that the dentin or pulp surface was exposed for grinding. Sections 2.5 mm and 1.5 mm thick were collected and fastened in one end of glass tubes four inches long by 1.5 cm inside diameter, by means of DeKhotinsky cement. The ground or polished surface was always placed toward the inside of the tube. The section thus held was set up as follows:

An outer vessel, a vial, a little longer than the tube supporting the section was supported by a clamp in a constant temperature water bath and in it were placed an electrode, bent at one end, fastened by a rubber band to the glass tube. Inside the tube another electrode was placed. In the first determinations platinum electrodes 0.75 cm in diameter were used, but later these were replaced

Plate I.



Cell for determining resistance of tooth sections

S. E. Pond
1919

by platinized gold. Into the outer and inner tubes was placed a solution of known hydrogen ion concentration. The electrodes were brought in contact with the section of tooth and then away from it two or three times to remove adherent gas bubbles. An arbitrary distance (about 0.5 cm) was left between the section and the electrodes, at which positions they were fastened tightly. By means of graduation on the glass electrode supports, this distance was nearly duplicated in successive experiments. The liquid in the vial and tube, after two hours, was pipetted off, fresh liquid poured on and left 24 hours, and thereafter changed each 24 hours, as long as

the observations were continued. The hydrogen ion concentration varies considerably in twenty to twenty-four hours and, hence, the electrical resistance was determined at regular, altho arbitrary, times. The results which follow were obtained by the Wheatstone Bridge method, using a tunable telephone receiver and oscillating current, two hours and twenty-four hours after the liquid had been changed. The resistance observed is obviously the resistance of the tooth section plus that of the two portions of liquid between the electrodes and the section. Controls were never satisfactorily obtained and no attempt has been made at present to estimate the specific nor equivalent resistances. The large changes, however, can presumably only come thru alteration of the tooth sections. The readings are all given of sections 2.5 mm thick—measured with micrometer caliper from flat ground surface to highest point on buccal or lingual surface. Thinner sections gave very variable readings, affording no idea of the change, in decided contrast to the thicker.

(b) Solubility of ground dentin-enamel.

Artificial Media), was divided, in five gram portions, among seven flasks in each of which was placed 25 cc of an acid solution—lactic and acetic were both used—and diluted until the hydrogen ion concentrations were pH 1.8, 2.8, 3.8, 4.8, 5.8, 6.8 at 25°C. respectively, and distilled water (pH-6.4). Controls of an equal volume of the acid solutions were preserved. All flasks (Erlenmeyer) (200 cc) were corked and covered with paraffined paper and placed at 37° C $\pm$ 1 °. The flasks were shaken at intervals of one-half hour thruout three, and three times on each of three additional, days. The flasks with the tooth material were opened on the sixth day, the liquid filtered, ten cc evaporated on a tared watch glass, cooled and dried to constant weight in a desiccator, and the hydrogen ion concentration of the remaining portion ascertained. The liquid without the tooth substance was not filtered but otherwise treated similarly. The results are expressed in Tables VIII and IX.

The solubility is apparently greater at higher hydrogen ion concentrations but little goes into solution until it is pH 5.8 or greater. The sample marked * had a heavy growth of mold which

TABLE VIII

Sections of Teeth from Mouths of Patients, 45-55 years

Temperature 37.5°C $\pm$ 0.02.

Hours	pH 1.8	2.8	3.8	4.8	5.8	6.8	7.8
0	110,000	92,000	108,000	99,000	95,000	85,000	90,000
24	90,000	80,000	100,000	99,000	95,000	84,000	90,000
48	82,000	75,000	95,000	99,000	95,000	84,000	90,000
72	75,000	76,000	94,000	99,000	95000,	82,000	90,000
240	74,000	74,000	94,000	88,000	92,000	82,000	
Total	36,000	18,000	14,000	11,000	3,000	3,000	0

TABLE IX

Age	1st Molar	Resistance in Ohms.
10-14	Permanent	22,000- 46,000
45-55	Permanent	88,000-110,000
?	Deciduous	58,000- 70,000

Some of the material from crowns as prepared for determinations in the first section of this report (I-pH Changes in

may account for the large residue (of a gelatinous-like consistency, and translucent on the watch glass).

(c) Prescription and solution of $Ca_3(PO_4)_2$.

Some observations on the precipitation of calcium phosphate from solution are included to indicate the apparent relation of precipitation and solution to

TABLE X

Weight in Milligrams

Original pH		1.8		2.8		3.8		4.8		5.8		6.8		H_2O	
		wt.	pH.	wt.	pH	wt.	pH	wt.	pH	wt.	pH	wt.	pH.	wt.	pH.
Series	A	*396.9	4.2	3.8	5.8	3.4	7.6	0.6	7.8	0.4	7.2	0.45	7.0	0.7	7.0
	B	34.5	6.8	4.5	6.2	4.6	7.0	1.2	7.4	1.0	7.6	0.5	7.2	0.65	6.5
	C	32.4	6.6	5.2	6.8	5.2	6.8	1.6	7.8	0.8	6.8	0.38	6.8	0.81	6.4
Control		0.62	1.8	0.46	2.8	0.51	3.8	0.42	4.8	0.38	5.8	0.4	6.8	0.6	6.3

the hydrogen ion concentration. Two solutions were made up, equivalent weight of (1) calcium chloride and mono-potassium phosphate and (2) calcium chloride and disodium phosphate. If the phosphate is dissolved first and the calcium chloride added as a solution, there will be a precipitate in the second but not in the first, and if an equivalent quantity of NH_3 in solution is added to the disodium phosphate solution the least soluble tertiary salt is precipitated. In the experiments reported, solution (1) was treated with M/10 NH_4OH and M/10 HC1 to effect precipitation and then solution in three series of 3/4x7 inch clear glass test tubes. Solution (2) was allowed to precipitate, decanted, washed with CO_2 free distilled water, centrifuged and dried, the salt pressed into five gram pills and the solubility determined at different hydrogen ion concentration at 37.5°C. To the test tubes with 10 cc of solution (1) calculated as M/100 $CaH_4(PO_4)_2$ (pH-4.8) were added, drop by drop, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, cc of M/10 NH_4OH. Two sets of tubes were immediately shaken while the third remained quiet. One of the former sets was used to determine the hydrogen ion concentration colorimetrically. The results are given in Table XI.

TABLE XI

Series	cc M/10 NH_4OH 0.5	1.0	1.5	2.0	2.5	3.0	3.5
I (pH)	5.6	6.1	6.4	6.8	7.2	7.5	7.7
II* (Shaken)	15+	15+	10	10	1.5	1.0	1.0
III* (Quiet)	50+	50+	20	40	20	20	?

*Time in minutes for precipitation to bottom of tube.

After 3.5 cc of the NH_4OH had been added, the addition slowly of 0.3 cc threw down a precipitate but none was apparent after this amount. The precipitate was cloudy to gelatinous on formation. In some initial precipitations in small graduated cylinders, an apparent increase in volume was observed—the maximum being with 3.0 cc of M/10 NH_4OH to 10 cc of the phosphate solution which was observed to have a volume of nearly 16 cc. The pipette and graduates used had a maximum deviation of nearly ½ cc in a total volume of 10 cc.

The addition of M/10 HC1—drop by drop—with a lapse between each addition of a few seconds for agitation, did not bring about complete solution until the pH was 5.0-5.2.

The pellets of the tertiary salt were shaken at frequent intervals during two days at 37.5° in 25 cc of acetic acid solution of pH 2, 3, 4, 5, 6, 7, 8. Two series of the pellets in the flasks were made up and, after the time referred to, were removed by filtration. From ten cc of the filtrate—no residue on evaporation to dryness was observed in excess of that from liquid of the same pH, but without pellets, in solutions of lower hydrogen ion concentration than pH 6, but a maximum dried residue of 3.5 mgms. was weighed from the solution having an initial pH 2. There has been no attempt to study solutions more acid than this, and no observations were made of the amount lost from the pellets with frequent change of solution to maintain it at nearly the initial, or a constant, pH, altho this might have been practicable.

It is likely there will be some question regarding the composition of the salt used in the last experiment. The sam-

ples of tribasic calcium phosphate were not analyzed to determine the composition but from the method of preparation and the solubility it would appear that the salt was either tribasic calcium phosphate or a solid solution of the dibasic salt, and calcium oxide. The solubility is low for the dibasic salt, however.

III. Proteolysis

With a view to further studying the possible relationship between bacterial metabolism and the disintegration of calcareous structures formed by living cells, an attempt has been made to ascertain whether or not there is any proteolysis of bacterial origin of dentin of the human tooth. The crowns of molar teeth freed from enamel by surface grinding have been used whole and in finely broken pieces—about one gram in all cases. They have been exposed to distilled water, an alkaline trypsin solution and cultures of streptococcus viridans and hemolyticus and B. subtilis and kept for different periods of time at 37°C. Samples of the cultures have been used to determine the hydrogen ion concentration and the amino acid nitrogen content. The cultures were kept pure and the trypsin and distilled water series kept sterile with toluol. After some weeks of variable results, a conclusion was drawn that the method of collecting samples in use was the cause of considerable error. Altho the variability is not fully explained by this, when the method was changed no such variability occurred. This will be described before the final results are indicated.

In order to study the precision of the amino nitrogen determination, Sörensen's formal titration method and the deamination method of Van Slyke were compared in an analysis of cultures of two different strains of B. diphtheria.

Cultures grown forty-eight hours on agar were washed in sterile distilled water and analyzed each twenty-four hours for change in NH_2 nitrogen, due to possible autolysis. Forty-eight-hour cultures grown in serum broth were transferred (a) 1/10 cc and (b) one loopful, to flasks of unborn veal broth. Plates indicated that 1/10 cc contained nearly 100,000 colonies. Twenty-five cc samples, after inoculation, and subsequently each twenty-four hours, were removed by sterile pipettes —15 cc placed in 100 cc Erlenmeyer flasks, and 10 cc in test tubes. The larger samples were treated with neutral formaldehyde and titrated with N/5 alkali. The smaller samples were used in the Van Slyke apparatus in 2 cc portions. All the readings from distilled water, with washings from agar slants, gave no indications of autolysis by the method of Sörensen, altho the Van Slyke determinations indicated a rise in twenty-four and forty-eight hours and then no further change. The readings from cultures were not constant after the first day and the Sörensen and Van Slyke readings did not agree. This was repeated in a number of series. Assuming that there was a difference due to concentration changes of bacterial content in relation to total volume of media, the method of sampling was changed. Instead of removing 25 cc samples, 300 cc flasks in excess of the number needed for analyses were prepared, 150 cc of media in each, and one flask removed from the incubator for NH_2 determinations each day. The irregular variations in results ceased. This led us to conclude that starting with a known volume and reducing by ten or twenty-five cubic centimeters each day, some fundamental relationship had been altered. For example, one flask early in the experiment had an initial volume of 115 cc. Removing 10 cc each day for six days, reduced the total volume to 55 cc. Each day shaking the flask to bring about uniform concentration of dissolved and suspended material and then drawing off a volume reduced the bacteria and the intermediate substances. Since the bacteria were multiplying, and thru

this process the intermediate substances being reduced, any further reduction in the intermediate bodies might easily be conceived to seriously affect the growth of the bacteria in the smaller volume of liquid. The relationship between bacteria and amino acids would not be so altered where, say ten, flasks of like volume were inoculated with arbitrary but similar volumes of bacterial suspensions. After this plan was adopted, tests both with Sörensen's and the Van Slyke methods yielded results nearly parallel. Differences between the two cultures were not observed, however, by the former and were regularly observed by the latter. The detection of an apparent autolysis and the difference between two strains of cultures, together with the ease of manipulation, led to the utilization of the Van Slyke method in the remaining work.

The streptococci used in the next experiments were isolated from an infected tooth root; B, subtilis, from a sample of Liebig's beef extract. The former were incubated on lactose, dextrose and mannite serum broth; ½ cc of a twenty-four-hour culture in dextrose serum broth was used in all inoculations. The greatest increase in amino nitrogen was observed in the dextrose broth, and with the teeth sections this only was used. The cultures of B. subtilis were used on beef extract bouillon—subinoculations made by loop after twenty-four hours incubation. In all cases the hydrogen ion concentration was on the alkaline side of neutrality after twenty-four hours and in a region where it has been assumed a tryptic, rather than an ereptic enzyme digestion proceeds. Pepsin obviously would not act in the region studied. In a final series a culture of streptococcus hemolyticus from E. C. Rosenow has been observed with and without tooth material in beef infusion bouillon.

Tables XII and XIII give the results of streptococci from the infected root; Table XIV the tests of B. subtilis with and without teeth sections; and Table XV the streptococcus hemolyticus from Rosenow, with and without teeth sections.

TABLE XII

Hemolyzing Streptococci

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
Dextrose	8	55.4**	67.8	75.4	78.9	82.6
	12	54.6	69.4	76.8	79.2	81.8
	14	58.6	70.4	78.9	79.8	82.5
	18*	55.6	56.0	56.4	56.6	56.8
Lactose	9	54.8	67.4	69.8	77.2	78.8
	13	55.2	68.1	69.9	76.5	77.4
	19*	55.9	56.2	56.25	56.28	56.8
Mannite	11	56.0	64.5	67.2	69.9	71.2
	15	56.4	65.4	68.1	70.2	72.4
	20*	55.9	56.4	56.8	56.7	56.9
pH Dextrose		8.8	8.6	8.4	8.0	7.6

* Controls.

** Mgms. per 100 cc.

TABLE XIII

Non-Hemolyzing Streptococci

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
Dextrose	1	54.9**	59.4	65.4	69.4	70.1
	4	55.1	61.2	66.8	69.9	69.7
	7	56.0	62.4	65.7	68.4	68.9
	16*	55.9	56.1	57.0	57.8	58.2
Lactose	2	55.2	57.2	57.8	58.8	59.2
	5	55.7	58.1	59.2	66.1	67.5
	17*	55.9	56.2	58.2	58.4	58.2
Mannite	3	55.4	57.2	59.0	61.0	61.2
	6	54.9	58.0	58.4	59.5	59.8
	10*	55.2	56.0	57.1	57.9	58.5

* Controls.

** Mgms. per 100 cc.

TABLE XIV

(a) B. Subtilis

In Beef Extract Bouillon

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
	1	49.6	55.8	69.8	199.4	149.8
	2	50.2	57.9	71.2	124.6	159.4
	3	49.8	61.2	80.0	120.2	157.6
Control	4	50.1	51.2	52.4	53.7	54.1
pH	2	6.9	7.2	7.4	8.0	8.2

(b) With 1 Gram Tooth Crown

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
	7	51.2	59.7	84.0	124.6	152.6
	9	50.8	69.2	79.2	131.4	157.0
	10	49.6	67.8	88.8	128.6	164.2
Control	5	50.8	51.4	52.8	54.7	55.2
pH	9	6.8	7.2	7.6	8.0	8.4

(c) With 1 Gram Ground Tooth

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
	12	50.7	57.2	92.3	137.8	155.4
	13	51.4	61.8	82.6	121.7	147.8
Control	6	51.0	52.0	52.4	53.2	53.7
pH	12	6.8	7.0	7.0	7.2	7.4

(d) With 1 Gram Ground Tooth

Broth Without Beef Extract

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
	17	12.7	28.7	32.9	78.2	78.0
	19	11.9	27.4	34.8	62.0	63.6
	20	12.4	26.9	35.2	61.9	62.1
Control	14	12.8	15.6	19.4	22.8	24.6
pH		7.0	7.4	7.4	7.6	7.6

Table XV

(a) Streptococcus Hemolyticus

Beef Infusion

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
	4	36.7	39.4	52.7	72.0	75.0
	5	38.2	41.2	44.6	64.6	72.0
Control	1	37.8	38.1	38.8	40.1	39.92
pH	4	7.2	7.6	7.8	8.0	8.0

(b) With 1 Gram Ground Tooth

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
	6	38.4	42.6	65.8	76.4	77.9
	7	37.9	46.8	72.0	75.0	78.4
Control	2	38.2	38.4	38.9	38.8	40.1
pH	7	7.1	7.3	7.8	7.8	8.0

(c) Streptococcus Hemolyticus

Broth Without Beef Infusion

Series No.		0 Hrs.	24 Hrs.	48 Hrs.	120 Hrs.	144 Hrs.
	9	12.8	20.6	36.8	61.2	62.4
Control	3	12.6	14.7	18.6	21.0	22.7

Table XVI

Trypsin

(a) With 1 Gram Whole Crown

Series No.		0 Hrs.	6 Hrs.	24 Hrs.	30 Hrs.
	11	21.2	22.4	22.4	22.5
	12	20.8	20.9	21.4	22.0
	13	20.6	20.8	22.2	22.4
Control	9	21.2	21.4	21.8	22.0

(b) With 1 Gram Ground Crown

Series No.		0 Hrs.	6 Hrs.	24 Hrs.	30 Hrs.
	14	21.8	21.9	22.9	23.1
	15	21.6	21.8	22.4	22.4
	16	20.6	21.2	21.6	21.8
Control	10	21.4	21.8	22.0	22.0

Table XVII

Distilled Water

(a) With 1 Gram Whole Crown

Series No.		0 Hrs.	24 Hrs.	36 Hrs.	48 Hrs.
	3	6.2	6.8	6.8	6.9
	4	6.0	6.4	6.6	6.9
	5	5.8	6.2	6.2	6.4
Control	1	6.0	6.2	6.2	6.2
pH	3	6.4	6.4	6.4	6.4

(b) With 1 Gram Ground Crown

Series No.		0 Hrs.	12 Hrs.	24 Hrs.	36 Hrs.	48 Hrs.
	7	6.4	6.2	6.4	6.4	6.6
	8	6.2	6.0	6.2	6.4	6.5
	6	6.4	6.4	6.5	6.5	6.6
Control	2	6.4				
pH		6.4	6.5	6.6	6.6	6.6

Tables XVI and XVII indicate practically no increase in amino nitrogen. This suggests that, if there is a "liquefaction" of dentin as is believed by many among the dental profession, it is not a hydrolysis of a protein of an alkaline acting enzyme. No attempt has been made to study the peptic or ereptic-like digestion of dentin.

Conclusions

The study reported in this paper defines the hydrogen ion concentration of two distinct groups of bacteria—one markedly acid and the other alkaline. Results indicate the region for B. acidophilus and bifidus at pH 4.5; for B. subtilis and streptococcus viridans pH 7.8-8.4. These organisms appear to transform medium with considerable rapidity. The acid region is one where the constituents of the enamel and dentin are dissolved rapidly; but no such change is apparent, nor would be anticipated, in the alkaline region indicated. The action of the organisms upon dentin, in an alkaline region, does not appear to increase the amino acid nitrogen content, and this is true, likewise, of trypsin acting in a similar region. This tends to disprove the "liquefaction of dentin" idea, as far as enzyme digestion in an alkaline region is concerned.

CAST FULL UPPER DENTURE WITH SPECIAL ATTENTION GIVEN TO ANATOMICAL FORM AND PHYSIOLOGICAL FUNCTION OF THE SOFT TISSUES

By CLAUDE J. STANSBERY, D.D.S., Seattle, Washington

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

WHEN we start to criticize the work of nature, developed in normal form with the view to increase function by making improvements in these forms, we had better stop before we begin. And it amounts to the same thing as criticism when we unthinkingly substitute other forms for hers. The only anatomical form of which I wish to speak and which is to be reproduced in dentures, either cast or vulcanite, is the form of the soft tissue of the mouth. An analysis of what we do when restoring contour of the face is nothing more than the restoration of natural labial contours within the mouth. This contour of the labial surface is more within the realm of the aesthetic than that of function.

Functionally, a denture is placed for speech and mastication. From the point of view of speech the palatal surface should reproduce the form of the vault in contour so that the proper size and shape of air spaces can easily be formed by the tongue. The rugae acts as high points to enable the tongue to do this more accurately. The convex roll just distal to the anterior teeth is essential for use in making the escapement and explosive sounds, and as this roll continues distally along the bicuspids and molars, it makes the correct contact with the sides of the tongue easy. However, I consider that the most important form for functioning is the abrupt contour of tissue adjacent to the gingival margin which acts as an auxiliary masticating surface, a shortstop to the food to prevent it from being forced too far palatally. We find that in normal teeth the forms are such that the excursions of food thru the embrasures and along the palatal grooves are such as to massage this most important tissue and keep it in a healthy tone. If this tissue is of sufficient importance for nature to make a tooth form for its care and health, surely it is of importance enough for us to reproduce. Not only does the construction of this form act as a shortstop, but we are enabled to make more normal palatal tooth surfaces and to make the teeth stand out and function more normally. (Every little thing even tho of small consequence in itself should be incorporated in the finished denture; for at best we know that the efficiency of an artificial denture falls far short of ideal function). Some one has compared the rugae to a plasterer's mortar board—the plasterer, in handling his mortar, throws it against the board, but he places it differently on his trowel. In a similar manner the tongue places the food against the rugae in order for it to take a new hold and present it for chewing from a new angle. Let nature's form be your guide in forming denture contours.

DISTILLED WATER IN PYORRHEA

By DOW R. BEEBE, D.D.S., Bridgeport, Connecticut

AT THE present time every dental magazine has articles on the treatment of pyorrhea alveolaris, most of which have real merit, but it is not the object of this article to specify any particular treatment but rather to tell of an aid to any treatment.

The writer has prescribed to his patients for the past twenty years the liberal and continual use of distilled water, and finds where it is faithfully used that the deposits on the teeth are soft, if there are any at all, and there is no irritation caused by whatever deposit there is.

You who have automobiles know that the directions as regards the care of the storage battery tell you to use distilled water. Why? Because the makers of the battery know that any minerals in other than distilled water will affect the solution and plates in the battery. So the same applies to the adult human system. The writer fully believes and it is carried out in practice that at the age salivary calculus begins to deposit, the system is showing that it has an excess of minerals by depositing calculus on the surfaces of the teeth. It is then time, after proper prophylactic precautions have been taken, to prescribe the drinking of distilled water to the exclusion of other water. The tea, coffee and cocoa should be made with distilled water. You should specify "double distilled water," as the kind used for storage batteries is not pure enough.

It is the writer's opinion that where considerable deposits of salivary calculus are on the teeth that you will find symptoms of calcic deposits thruout the system, and the curing of pyorrhea does not necessarily mean that the patient will be restored to health unless the cause, viz., calcic deposits, is removed permanently. It is also necessary that the patient should have an active system and the bowels kept open, preferably without the use of either laxatives or cathartics but with proper foods.

Physicians have been advising their patients for years to "drink lots of water." That was good as far as it went, but had they specified "double distilled water" they would have been on the right track. So let me repeat one suggestion, have the patient drink and use the distilled water exclusively and you watch the results.

Some one may ask, "why will distilled water prevent the depositing of salivary calculus"? The answer is, as there are no minerals in the distilled water, the excess of minerals in the system will be taken up by it. Others may say, "the system needs minerals." Surely, but proper foods will furnish all that is needed. Again, "will not faucet or spring water take up the excess minerals?" No, because any drinking water has already taken up all the minerals it can and more minerals would make it cloudy or muddy.

Do not confound boiled water with distilled water. Boiled water still has the minerals in it, only the animal matter has been eliminated.

The water company in our city manufactures the distilled water for drinking purposes and when the water is served cold is as good a drink as any spring water. If distilled water cannot be purchased, advise the patient to buy a still and distill his own.

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VOL. 8 FEBRUARY, 1921 No. 2

Editorial Department

INDEX OF DENTAL LITERATURE

One of the great forward movements, undertaken ten years ago by men of vision among our dental teachers, is the indexing and classifying of the articles in our dental periodical literature. Few realize today what this work means for the future growth of the profession. Since 1839, when our first journal was published, there have appeared several thousand volumes, which record our progress step by step; the multitude of articles is such that the entire mass long ago became inaccessible because of the impracticability of finding the articles on a given subject. If the work of the many men, who made the sacrifice of service that our profession might reach its present place in the sun, is to be

recognized and utilized for future building, it is necessary that we have easy access to their contributions.

The American Institute of Dental Teachers has announced the publication of an index volume of five hundred thirty pages, covering the periodical literature as published in the United States, England, Canada, Australia, and New Zealand, for the five years 1911 to 1915, and a second volume under way for the years 1916 to 1920. Each of these volumes will be in two parts; a subject index containing about twenty thousand items, titles arranged according to subjects; and an author index, containing about thirty thousand entries, including titles of books, papers, discussions, clinics, and biographies for each contributor. It is the intention to index the literature previous to 1911.

The Index has been made on the plan of the Dewey Decimal Classification in use by most of our public libraries, by which all of the articles on each subject are grouped, regardless of the wording of their titles. There is a separate department for each branch of dentistry with as many subdivisions as necessary, with a list of articles grouped under each heading. It is, therefore, a very simple matter to find what has been written on any desired subject.

The Index opens the door of the past and should strengthen the mind and hand of every practitioner for the future. Our literature reflects too little of the writings of those who have gone before. The constant restatements for facts indicate lack of acquaintance with previous contributions. The character of our journal articles should be an index of our professional achievement, yet there are few articles published today to which are attached adequate bibliographies.

One should not presume to write an article without acquainting himself with previous writings on his subject, yet it has heretofore been impossible to find what has been written. This has not been the fault of the individual contributor so much as the lack of development of the profession which would demand that our literature be made accessible.

This work has been done under the direction of Dr. Arthur D. Black, of Chicago. It has been financed by our dental colleges, societies, journals, and a group of about fifty practitioners. The House of Delegates of the National Dental Association voted to assist with the preparation of the second index volume. It is not a publication for profit. Every dentist who is interested in the advancement of the profession should subscribe for a copy and should forthwith begin the accumulation of a dental library, if he has not already done so. The price of the Index is $6.00. Orders should be sent at once to Dr. Abram Hoffman, 381 Linwood Avenue, Buffalo, New York.

STATE SOCIETIES

March

Kansas, at Wichita (21-26).
South Dakota, at Sioux Falls (March 28 to April 2).
Texas, at Dallas (3, 4, 5).
Vermont, at Rutland (16, 17, 18).

April

Alabama, at Montgomery (12, 13, 14).
Connecticut, at Waterbury (19, 20, 21).
Kentucky, at Louisville (13, 14, 15).
Michigan, at Detroit (11-16).
Missouri, at Springfield (25, 26, 27).
West Virginia, at Bluefield (11, 12, 13).

May

Arkansas, at Little Rock (no date given).
Illinois, at Peoria (10, 11, 12).
Indiana, at Indianapolis (16, 17, 18, 19).
Iowa, at Des Moines (3, 4, 5).
Massachusetts, at Boston (4, 5, 6).
Nebraska, at Omaha (no date given).
New York, at New York City (11, 12, 13, 14).
North Dakota, at Minot (no date given).
Pennsylvania, at Philadelphia (3, 4, 5).
Tennessee, at Nashville (17, 18, 19, 20).

June

California, at San Francisco (June 27 to July 2).
California (Southern) at Los Angeles (no date given).
Florida, at Gainesville (no date given).
Georgia, at Macon (8, 9, 10).
Maine, at Bar Harbor (21, 22, 23).
Maryland, at Baltimore (no date given).
New Mexico, at Albuquerque (no date given).
North Carolina, at Charlotte (no date given).
South Carolina, at Greenville (no date given).
Utah, at Salt Lake City (no date given).

July

Washington, at Vancouver, B. C.
Wisconsin, (12, 13, 14).

August

California, at San Francisco (9, 10, 11, 12).

VERMONT STATE DENTAL SOCIETY

The Vermont State Dental Society will hold its next annual meeting in Rutland, on Wednesday, Thursday, and Friday, March 16 to 18, 1921.

H. B. SMALL, *Secretary*
Burlington, Vermont

TENNESSEE STATE DENTAL ASSOCIATION

The fifty-fourth annual meeting of the Tennessee State Dental Association will be held at Nashville, May 17, 18, 19, 20, 1921.

J. J. VAUGHN, *Chairman*
Publicity Committee

IDAHO STATE DENTAL EXAMINATIONS

The next examination for dentists will be held on July 12, 1921. For application blanks and full information concerning this examination, address Bureau of License, Boise, Idaho.

PAUL DAVIS, *Director*
Bureau of License

MAINE DENTAL SOCIETY

The annual meeting of the Maine Dental Society will be held at Bar Harbor, Maine, June 21, 22, and 23, 1921.

B. C. GRAFFAM, *Secretary*
Portland, Me.

CALIFORNIA STATE DENTAL ASSOCIATION

The next annual meeting of the California State Dental Association will be held in San Francisco, June 27 to July 2, inclusive.

FRED J. SEIFERD, *Secretary*
909 Hyde St., San Francisco, Cal.

KANSAS STATE DENTAL ASSOCIATION

The next meeting of the Kansas State Dental Association will be held in Wichita, Kansas, March 21, 22, 23, 24, 25, 26, 1921. The first two days will be for open meetings, the remainder for postgraduate work.

C. K. WEAVER, *Secretary*

MASSACHUSETTS DENTAL SOCIETY

The fifty-seventh annual meeting of the Massachusetts Dental Society will be held in Boston, Massachusetts, at the Hotel Somerset, May 4, 5, and 6, 1921. A cordial invitation is extended to all members of recognized dental societies.

W. VERNON RYDER, *Secretary*
175 Newbury St., Boston, Mass.

PENNSYLVANIA STATE DENTAL SOCIETY

The fifty-third annual meeting of the Pennsylvania State Dental Society will be held in the Bellevue-Stratford Hotel, Philadelphia, May 3, 4, 5, 1921. An interesting and instructive program has been prepared. All ethical practitioners are invited to be present.

W. L. FICKES, *Secretary*
East End Trust Bldg., Pittsburgh, Pa.

SOUTH DAKOTA STATE DENTAL SOCIETY

The annual meeting of the South Dakota State Dental Society will be held in the Coliseum at Sioux Falls, South Dakota, March 28 to April 2, 1921. Postgraduate instruction will be featured. A cordial invitation is extended to all members of the National Dental Association.

ERNEST W. ELMEN, *Secretary*
608 Sioux Falls Nat'l Bank Bldg.,
Sioux Falls, S. D.

KENTUCKY STATE DENTAL ASSOCIATION

The next annual meeting of the Kentucky State Dental Association will be held in Louisville, Kentucky, April 13, 14, 15, 1921, with headquarters at the Seelbach Hotel. A clinical program of unusual interest is being arranged.

Address all correspondence to

W. M. RANDALL, *Secretary*
1035 Second St., Louisville, Ky.

MICHIGAN STATE DENTAL SOCIETY

The next annual meeting of the Michigan State Dental Society will be held at the Hotel Statler, Detroit, April 11-16, 1921. William H. Elliott, 7643 E. Jefferson Ave., Detroit, Michigan, is chairman of the Program Committee. W. H. Waller, 613 Washington Arcade, Detroit, Michigan, is in charge of exhibits. W. A. Cook, 422 McKerchey Building, Detroit, Michigan, is in charge of hotel reservations.

CLAUDE S. LARNED, *Secretary*
614 Post Bldg., Battle Creek, Mich.

THE DENTAL SOCIETY OF THE STATE OF NEW YORK

The Dental Society of the State of New York will hold the fifty-third annual meeting at the Hotel Commodore, Forty-second Street and Lexington Avenue, New York City, May 11, 12, 13, and 14, 1921. All literary exercises, clinics, and exhibitions will be staged at the Hotel Commodore. The society extends a most cordial welcome to all ethical dentists in New York and sister-states. Make reservations early at the Hotel Commodore. Exhibitors are requested to address Dr. H. C. Bennett, Chairman of the Exhibits Committee, 576 Fifth Avenue, New York City. For further information, address

A. P. BURKHART, *Secretary*
52 Genesee St., Auburn, N. Y.

ANNUAL CONVENTION OF THE TEXAS STATE DENTAL SOCIETY

The Texas State Dental Society will hold its forty-first annual convention on Thursday, Friday, and Saturday, March 3, 4, 5, 1921, at Dallas, Texas.

The Executive Committee is endeavoring to make this meeting an unusually attractive one, and to that end will not only utilize the best talent of the Society, but will bring in a few outside men of note. Clinics will be made a prominent feature.

On Monday following will commence the Society's second annual postgraduate class course, to continue one week and which will be conducted by the following instructors: Dr. Rupert R. Hall, Chicago; Dr. F. Ewing Roach, Chicago; Dr. T. W. Maves, Minneapolis; Dr. Arthur E. Smith, Chicago; Dr. Thomas B. Hartzell, Minneapolis; Dr. Clarence C. Simpson, St. Louis.

J. G. FIFE, *Secretary*
Dallas, Texas

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Delaware, at Wilmington, Municipal Building, Tenth and King Streets, January 12 and 13. W. S. P. Combs, Secretary, Middletown.

Idaho, July 12, Paul Davis, Director, Bureau of License, Boise.

Iowa, at Iowa City, College of Dentistry, February 7. C. B. Miller, Secretary, Fleming Building, Des Moines.

Massachusetts, at Boston, Harvard Dental College, Longwood Avenue, March 14, 15, 16, 17. J. N. Carriere, Secretary, 352 Main Street, Fitchburg.

Mississippi, at Jackson, Senate Chamber of the State Capitol Building, June 21. Burt J. Marshall, Secretary, Marks, Miss.

New Mexico, at Albuquerque, February 7. M. J. Moran, Secretary, Deming.

PHILADELPHIA DENTAL COLLEGE ALUMNI SOCIETY

The annual meeting of the Alumni Society of the Philadelphia Dental College will be held on Wednesday, April 20, 1921, at 9:00 A. M., in the College building at Eighteenth and Buttonwood Streets, Philadelphia. All members of the Alumni should note the date and arrange to be present. A reunion of the class of 1916, will be held on Tuesday, April 19, 1921. "All out and as you were."

H. D. Shields, *Publicity Committee,*
484 Roxborough Ave., Philadelphia, Pa.

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

The Massachusetts Board of Dental Examiners will hold a meeting for examination of candidates on March 14, 15, 16, and 17, at Harvard Dental School, Longwood Avenue, Boston. All applications must be filed with the Secretary at least ten days before examination.

For further particulars, applications, etc., address

J. N. Carriere, *Secretary*
352 Main St., Fitchburg, Mass.

ALUMNI SOCIETY OF THE DEWEY SCHOOL OF ORTHODONTIA

The next annual meeting of this society will be held on April 25 and 26 at the Hotel Ambassador in Atlantic City. The usual high standard of the meetings of this society will be maintained. Clinics and evening sessions will be included in the program. All interested in orthodontia are cordially invited to attend these meetings.

George F. Burke, *Secretary*
741-43 David Whitney Bldg., Detroit, Mich.

THE AMERICAN SOCIETY OF ORTHODONTISTS

The American Society of Orthodontists will hold its twentieth annual meeting at the Hotel Ambassador in Atlantic City, on April 27, 28, 29, and 30, 1921. A cordial invitation to attend this meeting is extended to all interested in orthodontia.

Ralph Waldron, *Secretary*
549 High Street, Newark, N. J.

CENTRAL DENTAL ASSOCIATION OF NORTHERN NEW JERSEY

The Central Dental Association of Northern New Jersey will hold its Mid-Winter Educational Meeting and Exhibit at the Robert Treat Hotel, Newark, New Jersey, March 1, 2, 3, 1921. The following program will be presented:

Practical Courses in Gold Inlays, Dr. R. H. Volland, University of Iowa; X-Ray Technic and Diagnosis, by a recognized authority; Physical Diagnosis, Dr. George H. Lathrop, Newark, New Jersey; Attachments for Partial Dentures and Saddle Constructions, Dr. G. Ewing Roach, Chicago, Illinois.

The following demonstrative postgraduate clinic courses will be given by sections of the Detroit Dental Clinic Club: Denture Prosthesis, Dr. William H. Giffen, Director; Porcelain Jacket Crowns and Baked Porcelain for Cleanliness in Bridge-Work, Dr. Albert LeLand LeGro, Director; Crown and Bridge-Work, Dr. William H. Elliott, Director.

The essay program so far includes Dr. A. W. Thornton, Montreal, Canada; Colonel Robert T. Oliver, Washington, D. C.; Dr. O. W. White, Detroit, Michigan.

The courses will be held from 2:00 P. M to 6:00 P. M. each afternoon, and the exhibits will be open from 10:00 A. M. to 10:00 P. M.

While this outline of our program is by no means complete, it will serve to give an idea of the extensive meeting we are planning to hold.

George B. Gallien
Chairman Publicity Committee
Glen Ridge, N. J.

DENTAL CORPS ORDERS FROM WAR DEPARTMENT

Dental Corps

Major Benjamin J. Durham, honorably discharged.

Chaplains Charles L. Andrews, James E. Dean, First Lieutenant Walter D. Love to San

Francisco and about February 4 to Hawaiian Department for duty.

DENTAL RESERVE CORPS

Appointment of James L. Miller as major, Dental Reserve Corps, to date from December 9, 1920, is announced; to active duty at Camp Pike, Ark.

Captain George J. Stephens to active duty in 8th corps area.

Captain Clarence A. Flanagan, First Lieutenant George E. Pendarvis report by telegraph to commanding general 9th corps area for assignment to duty and station.—*Army and Navy Register, January 15, 1921.*

Captain Milton A. Price from duty at Fairfield, Ohio, to Walter Reed General Hospital, D. C., for duty.

Captain William T. Williams will report by telegraph to commanding general, 5th corps area, for assignment to duty and station.—*Army and Navy Register, January 1, 1921.*

DENTAL CORPS

Major William D. White from duty at Alcatraz Island, Cal., to Fort McDowell, Cal., for duty.

Captain David I. Edwards from duties at Fort McDowell, Cal., and about February 4 to Hawaiian Department for duty.

First Lieutenant Clarence R. Benney from duties at Fort Rosecrans, Cal., to 9th Corps Area for duty.

First Lieutenant William J. Adlington from duty at Boston to Fort Riley, Kan., for duty.

Resignation by Captain Adrian C. Ragan accepted to take effect upon arrival in United States.

DENTAL RESERVE CORPS

Captain Robert L. Strickland to active duty at Camp Dix, N. J.

First Lieutenant Claude D. Holder to active duty at Camp Pike, Ark.—*Army and Navy Register, January 8, 1921.*

DENTAL CORPS

Captain Leslie S. Harlan, at Jefferson Barracks, Mo., is transferred to Fitzsimons General Hospital, Denver, Colo., for observation and treatment.

DENTAL RESERVE CORPS

First Lieutenant Harry M. Stephens to active duty in 8th corps area.

Colonel Robert Todd Oliver, Army Dental Corps, and Mrs. Oliver entertained the resident officers and wives of the Army Dental Corps with a tea dansant at the Army and Navy Club on January 15, 1921. The guests of honor were Surgeon General and Mrs. Ireland. The out-of-town guests were Dr. and Mrs. Homer C. Brown, Columbus, Ohio, and Dr. and Mrs. Otto U. King, Chicago, Ill. Others present were Colonel and Mrs. S. D. Boak, Colonel and Mrs. Alden Carpenter, Major and Mrs. D. G. Moore, Major and Mrs. L. S. Fountain, Major H. M. Dieber, Major and Mrs. R. M. McDowell, Major B. I. Newson, Major and Mrs. C. M. Taylor, Major and Mrs. Wm. O. Boss, Captain Walter D. Vail, Captain and Mrs. Eugene A. Smith, Captain and Mrs. W. B. Caldwell, Captain and Mrs. H. O. Lindsay, Captain and Mrs. J. B. Mann, Captain and Mrs. Roy L. Bodine, Captain and Mrs. T. L. Spoon, Captain B. M. Epes, Captain M. A. Price, Captain Arthur C. Foard, Captain and Mrs. J. A. Jaffer, and Captain Robert E. Motley.—*Army and Navy Register, January 22, 1921.*

UNITED STATES CIVIL-SERVICE EXAMINATION

DENTAL HYGIENIST

Receipt of Applications to Close March 1, 1921

The United States Civil Service Commission announces an open competitive examination for dental hygienist. Vacancies in the Public Health Service thruout the United States at $720 a year, plus quarters, subsistence, and laundry, or compensation therefor, usually at $62.50 a month, and vacancies in positions requiring similar qualifications, at this or higher or lower salaries, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

Bonus.—Appointees whose services are satisfactory may be allowed the increase granted by Congress of $20 a month.

Citizenship and sex.—All citizens of the United States who meet the requirements, both men and women, may enter this examination; appointing officers, however, have the legal right to specify the sex desired in requesting certification of eligibles.

Subjects and weights.—Competitors will not be required to report for examination at any place, but will be rated on the following subjects, which will have the relative weights indicated:

	Subjects	*Weights*
1.	Physical ability	25
2.	Education and experience	75
	Total	100

Basis of ratings.—Under the second subject competitors will be rated upon the sworn statements in their applications and upon corroborative evidence.

Registers and requirements.—Two registers of eligibles will be established from this examination, as follows:

(A) Those who have completed the eighth grade of common school and are graduates from an approved school of dental hygiene or from a recognized dental college.

(B) Those who are not graduates, but have had private training in a dental office for a period equal to that in a school of dental hygiene; or who have been accepted for registration by a State recognizing dental or oral hygienists. Register (B) will be used for appointment when eligibles from Register (A) are not available.

Age.—Applicants must not have reached their seventieth birthday on the date of the examination. At the request of an appointing officer certification will be made of eligibles who are within reasonable age limits.

Retirement.—Classified employees who have reached the retirement age and have served fifteen years are entitled to retirement with an annuity. The retirement age for railway mail clerks is 62 years, for mechanics and post-office clerks and carriers 65 years, and for others 70 years. A deduction of 2½ per cent is made from the monthly salary to provide for this annuity, which will be returned to persons leaving the service before retirement with 4 per cent interest compound annually.

Photographs.—Applicants must submit with their applications their unmounted photographs, taken within two years, with their names written thereon. Proofs or group photographs will not be accepted. Photographs will not be returned to applicants.

Medical certificate.—The medical certificate in the application form should be executed by a medical officer of the Public Health Service where practicable.

Applications.—Applicants should at once apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.; Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Calif.; Old Customhouse, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R.

Applications should be properly executed, *including the medical certificate,* but excluding the county officer's certificate, and must be filed with the Civil Service Commission, Washington, D. C., prior to the hour of closing business on March 1, 1921.

The exact title of the examination, as given at the head of this announcement, should be stated in the application form.

Preference.—Applicants entitled to preference should *attach to their applications* their original discharge, or a photostat or certified copy thereof, or their official record of service, which will be returned after inspection by the Commission.

Issued January 19, 1921.